MANUAL

OF THE

APIARY,

By A. J. COOK,

OF THE

MICHIGAN STATE AGRICULTURAL COLLEGE.

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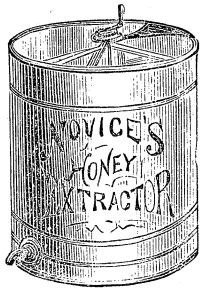

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MANUAL

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MICHIGAN STATE AGRICULTURAL COLLEGE.

TO THE

REVEREND L. L. LANGSTROTH,

THE

INVENTOR OF THE MOVABLE FRAME HIVE,

THE

HUBER OF AMERICA, AND THE GREATEST MASTER OF PURE AND APPLIED SCIENCE AS RELATING TO APICULTURE IN THE WORLD, THIS LITTLE MANUAL IS GRATEFULLY DEDICATED

BY

THE AUTHOR.

PREFACE.

THE APIARY.

Why another treatise on this subject? Have we not Langstroth, and Quinby, and King, and Bevan, and Hunter? Yes, all of these. Each of which has done excellent service in promoting an important industry. Each of which possesses peculiar and striking excellences. Yet none of these combine all of the qualities desirable in a popular manual. Hence the excuse for another claimant for public favor. Every cultured apiarist laments that there is no text book which possesses all of the following very desirable characters: Simple style, full in its discussions, cheap, disinterested, up with the times. It is for the bee-keeping public to decide whether this treatise meets any more fully the demands made by the latest discoveries and improvements, by the wants of those eager to learn, and by the superior intelligence which is now enlisted in the interests of the Apiary.

The following is, in substance, the same as the course of lectures which I have given each term to the students of the Michigan Agricultural College, and their desire, as expressed in repeated requests, has led to this publication.

It will be my desire to consider subjects of merely scientific interest and value, as fully as scientific students can reasonably desire; and, that such discussions may not confuse or perplex those who only read or study with practical ends in view, a very full index is added, so that the whereabouts of any topic, either of practical or scientific value, can be easily ascertained.

In considering the various subjects of interests to the bee-keeper, I am greatly indebted to the authors mentioned above, and also to the following journals, all worthy of high commendation: Gleanings in Bee Culture, American Bee Journal, Bee-keepers' Magazine, and Bee World.

The illustrations for this manual were nearly all drawn by the author from the natural object. The engravings were made by Miss S. E. Fuller, of New York, whose great skill is very worthy of high praise.

Figs 1, 3, 4, 17, 18 and 19 were kindly loaned by Luther Tucker & Son, of the Country Gentleman, and are from those volumes so valuable in every practical library: The Illustrated Annual of Rural Affairs.

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MANUAL OF THE APIARY.

CHAPTER I.

INTRODUCTION.

WHO MAY KEEP BEES?

Those of any profession or business,—who can give a little time in spring, summer, and autumn, who may desire to be associated with, and study natural objects, and supplement their present means of increasing their income,—provided, they have a little ground three or four rods from the street. Thus, citizens of country, village, or city, male or female, who wish to add to the pleasures and profits of life, will here find an ever-waiting opportunity. To the ladies, so often shut out from fresh air and sunlight, till palor and languor point sadly to departing vigor, and to those men, the nature of whose business precludes air and exercise, the apiary offers special attractions.

INDUCEMENTS TO BEE-KEEPING.

This has been called the poetry of rural pursuits, and very properly too. There is a fascination about the apiary that is indescribable. Nature is always presenting the most pleasurable surprises to those on the alert to behold them. And among insects, especially bees, the instincts and habits are so inexplicable and marvelous, that the student of this department of nature never ceases to meet with exhibitions that startle him, no less with wonder than with admiration. Show me a scientific bee-keeper, and I will show you an enthusiast. A thorough study of the wonderful economy of the hive, must from its very nature go hand in hand with delight and admiration. Said I, a short time since, to an extensive apiarist who also owns a fine large farm, "Why do you keep bees?" The reply was characteristic: "Even could I not make a good deal the most money from my bees, I should still keep them for the real pleasure they bring me."

Again, there is no other manual labor pursuit in which the returns are so large, compared with the labor and expense. An experienced apiarist may invest in bees any spring in Michigan, with the absolute certainty of more than doubling his investment the first season, while a net gain of four hundred per cent. causes no surprise to the bee-keepers of our State. During the past season an investment in bees has returned to me five hundred per cent., and though this has been a good season for honey, yet I have done better than this several times. No less than three farmers of our State who possess good improved farms, and also keep about one hundred colonies of bees, have told me within a few weeks that their income from their bees far exceeded that from their farms. What greater recommendation has any vocation? Money getting, even with the greatest privations is attractive, and is slighted by *no* class. Money

getting, with labor that brings, *in itself*, constant delight, leaves little to be desired.

Bee-keeping, too, on a limited scale, demands very little time; and since the pleasures would be just as great with but few colonies, no one would object to thus add to his income. I know, in fact, of no business (and I speak from experience) that is so convenient and desirable as an avocation. To the man with sedentary habits, it brings wholesome exercise; to the man tied to an office, air and exercise; to the clerk and factory hand, or others, whose lives are monotonous and machine-like, it gives occasion for intellectual effort; and, in inciting to thought and study, makes them feel more truly that they are men. To our sisters, it offers all the above attractions, and, more, may serve to drive the wolf from the door. To all of us, who become successful apiarists, it spreads an intellectual feast that the old philosophers would have envied, furnishes the rarest food for the observing faculties, and brings us into that intimate communion with nature which is never-failing in its tendency to refine the tastes, elevate the feelings, and ennoble manhood.

WHAT SUCCESSFUL BEE-KEEPING REQUIRES.

No one should commence this business who is not willing to read, think, and study. To be sure, the unthinking may stumble on success for a time, but sooner or later failure will set her seal upon his efforts. Those of our apiarists who have studied the hardest, observed the closest, and thought the deepest, have even passed the late terrible winters with but slight loss.

Prompt attention to the needs of his industrious little servants, is another absolute requirement. To be sure, this attention is slight, and so is apt to be neglected; but always with loss,—often with disaster. That "bees work for nothing and board themselves" is only comparatively true. Their demands are indeed light; but they *must be* met.

Enthusiasm, or real love for the business, is another requisite. This is a plant whose growth, with the least opportunity, is sure. It only demands persistence. The beginner, without either experience or knowledge, may meet with discouragements,—undoubtedly will. Swarms will be lost, others will fail to winter, the young apiarist will become nervous,—which will disgust the bees in so much that they will essay to administer reproof of a sharp and pointed kind. Yet, with *persistence* all of these difficulties will fade away. Every contingency will be foreseen and provided against, and the myriad little workers will become as manageable and may be fondled as safely as a pet dog or cat. And the apiarist will minister to their needs with the same fearlessness and self-possession that he would attend to his gentlest cow or favorite horse. Persistence in the face of those discouragements, which are so apt to confront inexperience, will surely triumph. For he who has one jot of appreciation of the beautiful and the marvelous in his character will soon grow to love his insect pets, and the labor attendant upon their care and management, and this love will soon kindle into enthusiasm.

CHAPTER II.

THE BEE'S PLACE IN THE ANIMAL KINGDOM.

THE BRANCH OF THE HONEY-BEE.

The Honey-bee belongs to the great branch of animals known as Articulates, a very appropriate name given by the great French naturalist Cuvier, as it refers to the ring or jointed structure which characterizes all the animals of the group, whether worms, crustacea—which includes the lobsters, sow-bugs, and barnacles—or true insects. These rings form a skeleton, which, unlike that of the higher vertebrate branch, is external, and this serves to protect the softer inner parts, as well as to give strength and solidity. An examination of a bee will quickly reveal these rings, while in our beautiful Italians coloration makes them show even more plainly.

CLASS OF THE HONEY-BEE.

Our subject belongs to the class Insecta, which is characterized by breathing air usually through a very complicated system of air tubes. These tubes are very peculiar in their structure, as they are formed of a spiral thread, and thus resemble a hollow cylinder which might be formed by closely winding a fine wire about the finger, and then withdrawing the latter, the wire remaining unmoved. These tubes are constantly branching and are almost infinite in number. Nothing is more surprising and interesting than this labyrinth of beautiful tubes as seen in dissecting a bee under the microscope. I have frequently detected myself taking long pauses in making dissections of the honey-bee, as my attention would be fixed in admiration of this beautiful breathing apparatus. Doubtless all of my readers have associated the quick movements and surprising activity of birds and most mammals with their well developed lungs. So, too, in such animals as the bee we see the relation between this intricate system of air-tubes—their lungs—and the quick, busy life which has been proverbial of them since the earliest times.

ORDER OF THE HONEY-BEE.

Our bees belong to the order Hexapods, or true Insects. The first term is appropriate, as all have in the imago or last stage, six legs. Nor is the second term less applicable, as the word insect comes from the Latin and means to cut in, and in no other articulates does the ring structure appear so marked upon merely a superficial examination. More than this, the true insects when fully developed, have unlike all other articulates, three well marked divisions of the body, namely: the head, which contains the antennæ—the horn-like appendages common to all insects; eyes and mouth organs; the thorax, which bears the legs, and wings, when they are present; and lastly, the abdomen, which, though usually memberless, contains the ovipositor, and when present, the sting. Insects, too, undergo a more striking metamorphosis than do most animals. When first hatched they are worm-like and called larvæ, which means masked; afterward they are frequently quiescent, and would hardly be supposed to be animals at all. They are then known as pupæ. At last there comes forth the imago with compound eyes, antennæ, and wings. In some insects the transfor-

mations are said to be incomplete, that is the larva, pupa, and imago differ little except in size, and that the latter possesses wings.

SUB-ORDER OF THE HONEY BEE.

The honey bee belongs to the sub-order Hymenoptera, which also includes the wasps, ants, ichneumon-flies and saw-flies. This group contains insects which possess a tongue by which they may suck (see Fig. 12 *a*), and strong jaws (see Fig. 12 *c*) for biting. Thus the bees can sip the honeyed sweets of flowers, and also gnaw away mutilated comb. They have, besides, four wings, and undergo complete transformations.

FAMILY OF THE HONEY BEE.

The honey bee belongs to the family Apidæ. Insects of this family have robust bodies, usually very hairy, large heads, prominent eyes,—which in the males meet above,—elbowed antennæ, and very long tongues. Many of these are social, and besides the true females, every colony possesses those with abortive ovaries, which are called neuters or workers. This group includes the wax-secreting bees, and the humble-bees, which do not build wax cells, but simply lay their eggs in the pollen masses, and the larvæ, by feeding on the pollen, hollow out egg-shaped cavities, which become the honey cells. Thus *some* larvæ feed only on pollen. Others of this family are solitary, like the carpenter bee, which bores in wood; the sand-bee, which digs in the earth; and the tailor bee, which cuts those regular pieces, circular or oblong, from our rose-leaves or rose-petals, and from which it forms its wonderful thimble-shaped cells. Thus we see that all the insects of this family possess strange instincts, and habits so curious that few subjects of study yield more real pleasure and gratification.

GENUS OF THE HONEY-BEE.

The genus Apis is characterized by the peculiar structure of the mouth-parts and the venation of the wings. But to particularize would lead me too deeply into the details of structure.

SPECIES OF THE HONEY-BEE.

The scientific name of the honey-bee is Apis mellifica, and the species will be fully described as we proceed to explain its natural history and habits. The races of the honey-bee will also be more appropriately considered in the sequel.

CHAPTER III.

NATURAL HISTORY OF THE HONEY-BEE.

Close examination of any prosperous colony of bees, in the summer season, will discover a marked difference in the individuals composing it. A large majority will appear small, a few hundred large and heavy, while a single one will fix attention by her long, tapering abdomen. Thus we have the workers, drones, and queen: the first being undeveloped females, called neuters; the second, males; and the last the fully developed female. Let us examine these in detail.

THE NEUTERS, OR WORKER-BEES.

These (see Fig. 1) are by far the most numerous individuals of the hive, there being from 20,000 to 40,000 in every good colony. They are also the smallest members of the colony, measuring but little more than one-half inch in length, and being only two-thirds the length of the queen. They also possess peculiarities of structure which at once distinguish them from both the queen and drones. Their tongues (see Fig. 12) are almost twice as long as in either the drone or queen; their jaws are much stronger; their wings, like the wings of the drone, attain the extremity of the body, while the tibia and tarsi—names given to the last joints of the legs—of the posterior legs are hollowed out,

FIG. 1.

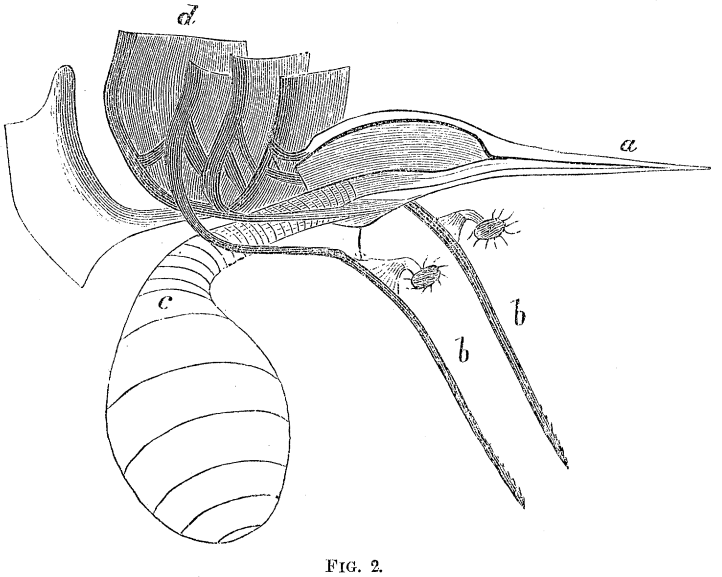

FIG. 2.

forming pollen-baskets, in which respect they differ from both the drones and the queen; the eyes do not differ from the same in the queen, but are smaller than those of the drone, and do not meet above.

The workers also possess a natural weapon of defense, the sting (see Fig. 2), which they are free to use as occasion requires. The mechanism of this organ is very interesting. At its base is a double gland, which secretes the poison; which, when secreted, is poured into an ample poison sack (Fig. 2, *c*), which is as large as a flax seed. The sting proper is a triple organ, consisting of three sharp spears, very smooth and of exquisite polish, which lie side by side, and make up the sting as seen by the naked eye. The central lance (Fig. 2, *a*) is hollow,—a little shorter than the others. The central opening connects with the poison sack, so that the poison all passes through this part of the sting. The side pieces (Fig. 2, *b b*) are marvelously sharp, and each barbed at the end with teeth, of which seven are prominent, and which extend out and back like the barb of a fish-hook, so that the sting cannot be withdrawn when once fairly used, and with its loss the bee's life is sacrificed. These side pieces are worked alternately by small muscles (Fig. 2, *d*) at the base of the sting, and when fairly inserted the poison is intruded through the central piece. The workers also possess a honey stomach (Fig. 3), or crop, in which the honey is carried to the hive.

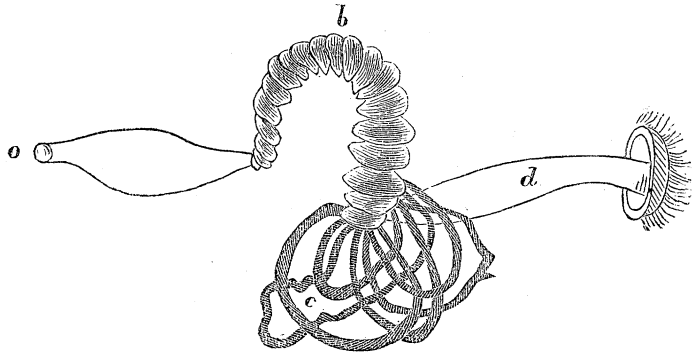

FIG. 3.

Alimentary Canal.—*a*, honey stomach; *b*, true stomach; *c*, urinary tubes; *d*, intestine.

The workers always hatch from an impregnated egg, which can only come from a fertile queen, and is always laid in the small horizontal cells (see description of comb and Fig. 11). The eggs are in the form of a short, slightly-curved cylinder, and are fastened by one end to the bottom of the cell. They can be easily seen by holding the comb so that the light will shine into the cells.

FIG. 4.

The eggs hatch in about four days. The larva (Fig. 4) is white and footless, and lies coiled up, floating in the whitish fluid previously placed in the cell. This food is composed of pollen and honey, and is all consumed by the larva. In about five days the cell is capped over by the bees. The cap is composed of pollen and wax, so that it is darker, more porous, and more easily broken than the honey caps. It is also more convex. The larva, now full grown, commences to surround itself with a thin cocoon made of fine silk, and in three days assumes the pupa state (Fig. 5), when it is called a nymph. It now looks like the imago or fully developed bee, except that the legs, wings, and tongue are folded on the breast, and the insect is now colorless. Upon the twenty-first day the bee emerges from the cell.

FIG. 5.

The worker bees never attain a great age. Those reared in autumn may live for nine months, while those bred in spring will wear out in three. None of the worker bees survive the year through. So there is a limit to the number which may exist in a colony. Their longevity depends upon their activity, and hence upon the time of year in which they live.

The function of the worker bees is to do all the manual labor of the hive. They secrete the wax, which forms in small pellets beneath the abdomen, build the comb, feed the young bees, or, rather, the larvæ, and cap the cells, whether they be brood or honey cells. Thus far the work is done by the younger bees. The older bees gather the honey, collect the pollen, or bee-bread, as it is generally called, bring in the propolis, or bee-glue, which is used to close up openings, and as a cement, supply the hive with water, defend the hive from all improper intrusion, destroy drones when their day of grace is past, kill and arrange for replacing worthless queens, and lead forth a portion of the bees when the conditions impel them to swarm.

THE DRONES.

The male bees (Fig. 6) are only found in the hive from May till November, when there will be a few hundred, though the number may be controlled by the Apiarist, and should be greatly reduced. These are longer than the workers, being nearly $\frac{3}{4}$ of an inch in length and more bulky than either the queen or neuters. Their flight is heavy, and they may be known by their deep, low hum. Their tongue is short, jaws weak, and their posterior members destitute of pollen baskets. The eyes meet above, and are very prominent. The drones, too, have no defense organ, the sting being absent.

FIG. 6.

The male bees come from unimpregnated eggs, a fact which, though it almost staggers credulity, is easily proved, and beyond question. These eggs may come from an unimpregnated queen, a fertile worker,—for very rarely a worker bee will deposit eggs, such bees doubtless meeting in part the conditions which we shall see in the sequel produce queens,—or from an impregnated queen, which may voluntarily prevent impregnation. Such eggs are placed in the larger horizontal cells (Fig. 11) in the same manner as the worker eggs are placed in the smaller cells. The capping of the drone cells is very convex, and protrudes beyond the general level of the comb, so that drone brood is very easily distinguished from worker, and, from the darker color of the capping, both drone and worker brood are very readily distinguished from honey. The development of the drones from egg to larva, to pupa, and to imago, is essentially like that of the workers, though they do not come forth till the twenty-fourth day from the laying of the egg. Of course difference of temperature and other conditions may slightly advance or retard the development of any brood in the different stages. The drones,—in fact all bees,—when they first emerge from the cells, are gray, soft, and appear unsophisticated generally.

Just what the longevity of the male bee is I am unable to state. They appear in May and are destroyed in October and November. It is not improbable that some may live during the entire time.

The function of the drones is solely to impregnate the queens. This is done on the wing, outside the hive, usually during the heat of warm, sunshiny days. After mating, the drone organs adhere to the queen, and their abstraction is fatal to the life of the drone. As a queen never meets but a single drone, and

that only once, it might be asked why nature was so improvident as to decree hundreds of drones to an apiary or colony, whereas a score would suffice as well. Yet nature takes cognizance of the importance of the queen, and as she goes forth amidst the myriad dangers of the outer world, it is safest and best that her stay abroad be not protracted; hence the superabundance of drones, —especially under natural conditions, isolated in forest homes, where ravenous birds are ever on the alert for insect game,—is most wise and provident. Artificial circumstances require no such conditions, nor are they then enforced.

THE QUEEN.

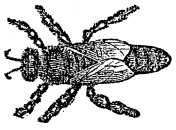

FIG. 7.

The queen (Fig. 7) is the true mother bee, or in other words a perfectly developed female, with large, full-formed ovaries, which occupy the larger part of her abdomen. These organs (Fig. 8), one on either side of the back, are multitubular, each consisting of many tubes (Fig. 8, *a a*), in which grow the eggs, for the eggs of all animals are a growth, not a secretion. From each ovary leads a special duct (*b*, Fig. 8), which ducts finally unite into the common oviduct (*c*, Fig. 8), through which all the eggs pass. By the

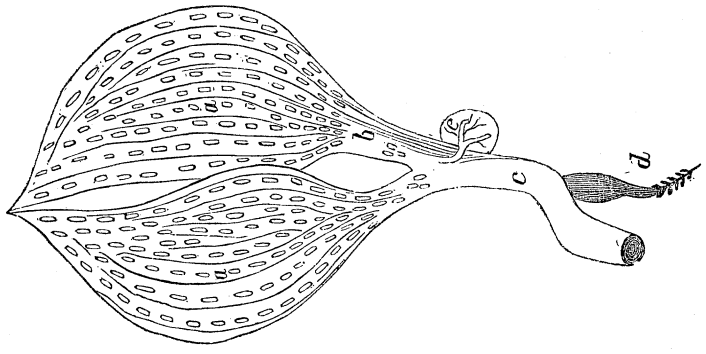

FIG. 8.

side of this oviduct is a little pea-shaped sock (*e*, Fig. 8), called the spermatheca, which, during copulation or mating, is filled with the seminal or male fluid. About this sock are voluntary muscles, so that the queen can bring the fluid, if she desires, in contact with the eggs as they pass. This, of course, is the most important structural peculiarity of the queen, as this makes her a female, but she has other differences worthy of mention: she is longer than either drone or worker, being over seven-eighths of an inch long, and with her long, tapering abdomen is not without real grace and beauty. The queen's tongue (Fig. 9) is short, her jaws weak, eyes like the neuter's, wings short, hardly more than half the length of the abdomen. She has no pollen-baskets, but possesses a sting which resembles that of the humble-bee, in being curved (see *d*, Fig. 8), yet, strange as it may appear, she can seldom be induced to make use of it. I have often tried to provoke a queen's anger, but never with any evidence of success.

The queen, like the neuters, is developed from an impregnated egg, which of course could only come from a fertile queen. These eggs are not placed in a horizontal cell, but in one specially prepared for their reception. These queen cells (Fig. 11) are usually built on the edge of, or around an opening in the

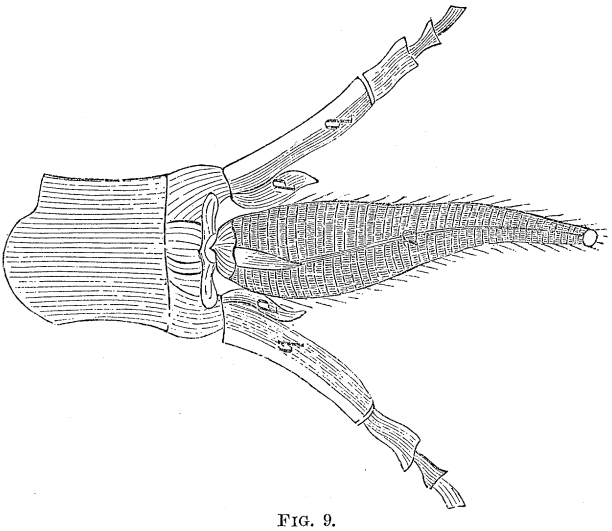

FIG. 9.
a, tongue, or ligula; *b*, labial palpi; *d*, paraglossæ.

comb, extend either vertically or diagonally downward, and much resemble a thimble or a pea-nut in form and size. The eggs are placed in these cells, either by the worker bees, which transfer them from worker cells, or else by the queen. Some apiarists doubt that the queen ever places an egg in a queen cell, but I have no doubt of the fact, though I never witnessed the act. I have frequently seen the eggs in these cells in exactly the position which the queen always places her eggs. Nor have I much respect for the arguments which are built on an inferred discord between the queen and neuters. I believe there is a better understanding between the inmates of the hive than is generally believed by apiarists. It is probably true that the actions of the bees are influenced and controlled by circumstances or conditions, but I have yet to see satisfactory proof that these conditions differently impress the queen and workers. The conditions which usually lead to the building of queen cells and the peopling of the same, are loss of queen, inability of queen to lay fertile eggs, and too great numbers of bees, or too little room in the hive, which is likely to be true in times of great honey secretion. The queen may be developed from an egg or from a worker larva less than three days old, which will then be transferred from a worker to a queen cell. The development of the queen is much the same as that of a worker, though she is fed richer and more plenteous food, called royal jelly. So abundant is this royal pabulum that there is always some remaining in the cell after the queen issues. It is probable that the more profuse and sumptuous diet, perhaps aided by a more ample habitation, is what accelerates and perfects the development of her royal highness. Yet the fact of fertile workers, and the easy probability of their having received a little richer and more plenteous diet than their sisters, would lead us to suppose that the food, both as to quality and quantity, is what had most influence. The cocoon surrounding the queen nymph or pupa is imperfect next the outer end of the cell. It has been supposed by some that this was an act of thoughtfulness on the part of the queen larva, thus to render her own destruction more easy, should the welfare of the colony demand it. In sixteen days from the laying of the egg, or from

ten to twelve days from the starting of a queen from the worker larva the queen issues from her cell. As the queen's development is probably mainly due to superior character and quality of food, it would stand to reason that queens from the eggs are preferable; and under normal circumstances I believe the bees in nature thus start them nearly always. The best experience sustains this conclusion. As the proper food and temperature could best be secured in a full colony—and here again the natural economy of the hive adds to our argument—we should infer that the best queens would come from strong colonies. Experience also confirms this view.

Five days after issuing from the cell, if the day is pleasant, the queen goes forth on her "marriage flight," otherwise she will improve the first pleasant day for this purpose. If she fails to find an admirer the first day, she will go forth again and again till she succeeds. If the queen is observed upon her return from the wedding tour, it may be easily determined whether or no she has been successful, for if she has she will bear suspended to her body the organs of the drone. If the queen lays any eggs before meeting the drone, or if for any cause she fails to meet the drone, the eggs will of course only produce drone bees. About two days after fertilization takes place the queen commences under normal circumstances to lay worker eggs, and the first year lays few others.

The queen, when considered in relation to the other inhabitants of the colony, possesses a surprising longevity. It is not uncommon for her to attain the age of three years in the full possession of her powers, while queens have been known to live even five years. Queens, often at the expiration of one, two, three, or four years, depending upon their vigor and excellence, either cease to be fertile or else become impotent to lay any but drone eggs, the spermatheca having become emptied of the seminal fluid. In such cases the workers usually supersede the queen; that is, they destroy the old queen and start queen cells for the purpose of rearing young, fertile, and vigorous queens.

The function of the queen is simply to lay eggs, and thus keep the colony populous; and this she does with an energy that is fairly startling. A good queen in her best estate will lay two or three thousand eggs a day. Yet with even these figures as an advertisement, the queen bee can not boast of superlative fecundity, as the queen white-ant—an insect closely related to the bees in habits, though not in structure, as the white-ants are lace-wings and belong to the sub-order Neuroptera, which includes our day-flies, dragon flies, etc.—is known to lay over 80,000 eggs daily. Yet this poor helpless thing whose abdomen is the size of a man's thumb, and composed almost wholly of eggs, while the rest of her body is not larger than the same in our common ants, has no other amusement. She cannot walk, she can not even feed herself or care for her eggs. What wonder then that she should attempt big things in the way of egg-laying? She has nothing else to do or to feel proud of. Different queens vary as much in fecundity as do different breeds of fowls. Some queens are so prolific that they fairly demand hives of india rubber to accommodate them, keeping their hives fairly gushing with bees and profitable activity, while others are so inferior that the colonies make a poor sickly effort to survive at all, and usually succumb early, before those adverse circumstances which are ever waiting to confront all life on the globe.

The old poetical notion that the queen is the revered and admired sovereign of the colony, whose pathway is ever lined by obsequious courtiers, whose person is ever the recipient of loving caresses, and whose will is law in this bee-hive

kingdom, controlling all the activities inside the hive, and leading the colony whithersoever they may go, is unquestionably mere fiction. In the hive, as in the world, individuals are valued for what they are worth. The queen, as the most important individual, is regarded with solicitude, and her removal or loss noted with consternation, as the welfare of the colony is threatened; yet, let the queen become useless, and she is despatched with the same absence of emotion that characterizes the destruction of the drones when they have become supernumeraries. It is very doubtful if emotion or sentimentality are ever moving forces among the lower animals. There are probably certain natural principles that govern in the economy of the hive, and aught that conspires against, or tends to intercept the action of these principles, becomes an enemy to the bees. All are interested, and doubtless more united than is generally believed, in a desire to promote the free action of these principles. No doubt the principle of antagonism among the various bees has been overrated. Even the drones when they are being killed off in the autumn make a sickly show of defense, as much as to say, the welfare of the colony demands that such worthless vagrants should be exterminated; "so mote it be, go ahead." The statement, too, that there is often serious antagonism between the queen and workers, as to the destruction or preservation of inchoate queens, yet in the cell, is a matter which may well be investigated. It is most probable that what tends most for the prosperity of the colony is well understood by all, and without doubt there is harmonious action among all the denizens of the hive, to foster that which will advance the general welfare, or to make war on whatever may tend to interfere with it. If the course of any of the bees seems wavering and inconsistent, we may rest assured that circumstances have changed, and that could we perceive the bearing of all the surrounding conditions, all would appear consistent and harmonious.

CHAPTER IV.

SWARMING, OR NATURAL METHOD OF INCREASE.

The natural method by which an increase of colonies among bees is secured is of great interest, and though it has been closely observed and accurately studied for a long period, and has given rise to theories which were as often absurd as sound, yet, even now, it is a fertile field for investigation, and will surely repay any who may come with the true spirit of inquiry, for there is much concerning it which is involved in mystery. Why do bees swarm at unseemly times? Why is the swarming spirit so excessive at times and so restrained at other seasons? These and other questions we are too apt to refer to erratic tendencies of the bees, when there is no question but that they follow naturally upon certain conditions perhaps intricate and obscure, which it is the province of the investigator to discover. Who shall be first to unfold the principles which govern in these as in all other actions of the bees?

In the spring or early summer, when the hive has become populous and storing very active, the queen, as if conscious that a home could be overcrowded, and forseeing such danger, commences to deposit drone eggs in drone cells,

which the worker bees, perhaps moved by like considerations, begin to construct, if they are not already in existence. In fact, drone comb is almost sure of construction at such times. No sooner is the drone brood well under way than the large awkward queen-cells are commenced, often to the number of ten or fifteen, though there may be not more than three or four. In these eggs are placed, and the rich royal jelly added, and soon, often before the cells are even capped, some bright day, usually about ten o'clock, after an unusual disquiet both inside and outside the hive, a large part of the worker-bees, having previously loaded their honey-sacks, rush forth from the hive as if alarmed by the cry of fire, the queen among the number, though she is by no means among the first, and frequently is quite late in her exit. The bees thus started on their quest for a new home, after many uproarious gyrations about the old one, dart forth to alight upon some bush, limb, or fence, though in one case I have known the first swarm of bees to leave at once for parts unknown without even waiting to cluster. After thus meditating for the space of from one to three hours upon a future course, they again take wing and leave for their new home, which they have probably already sought out. If for any reason the queen should fail to join the bees, and perhaps rarely, when she is among them, they will, after having clustered, return to their old home. The youngest bees will remain in the old hive, to which those bees which are abroad in quest of stores will return. The presence of young bees on the ground,—those with flight too feeble to join the rovers,—will always mark the previous home of the emigrants. Soon, in about eight days, the first queen will come forth from her cell, and in two or three days she will or may lead a new colony forth, but before she does this the peculiar note, known as the piping of the queen, may be heard. At successive periods of one or two days one, two, or even three more colonies may issue from the old home. These last swarms will all be heralded by the piping of the queen. They will be less particular as to the time of day when they issue, and as a rule will cluster farther from the old hive.

The cutting short of swarming preparations before the second, third, or even the first swarm issues is by no means a rare occurrence. This is done by the bees destroying the queen cells, and sometimes by a general extermination of the drones, and is generally to be explained by a cessation in the honey yield.

CHAPTER V.

THE PRODUCTS OF THE HIVE, WHERE AND HOW OBTAINED, AND FOR WHAT PURPOSE.

HONEY.

Of course the first product of bees, not only to attract attention, but also in importance, is honey. And what is honey? We can only say that it is a sweet substance gathered from flowers and other sources by the bees. We cannot, therefore, give its chemical composition, which would be as varied as the sources from which it comes. We cannot even call it a sugar, for it may be, and always is composed of various sugars, and thus it is easy to understand why

honey varies so much in richness, color, flavor, and effects in digestion. In fact, it is very doubtful if honey is a manufactured article at all. It seems most likely that the bees only collect it as it is distilled by myriad leaves and flowers, and store it up that it may minister to their and our necessities. To be sure, some writers contend that it undergoes some change while in the bee's stomach; but the rapidity with which they store, and the seeming entire similarity between honey and sugar fed to them, and the same immediately extracted from the comb has led me to believe that the transforming power of the stomach is very slight, if indeed it exists at all. The method of collecting the honey is for the bee to insert her long tongue into the flower till it reaches the honey, which, by suction, is drawn into the sucking stomach. When the stomach is full the bee repairs to the hive and regurgitates its precious load, storing it in the cells. When there are no flowers, or when the flowers yield no sweets, the bees, ever desirous to add to their stores, frequently essay to rob other colonies, and often visit the refuse of cider mills, or suck up the oozing sweets of various plant or bark lice, thus adding, may be, unwholesome food to their usually delicious and refined stores. It is a curious fact that the queen never lays her maximum number of eggs except when storing is going on. In fact, in the interims of honey-gathering, egg-laying not infrequently ceases altogether. The queen seems discreet, gauging the size of her family to the probable means of support.

Again, in times of extraordinary yields of honey, the storing is so rapid that the hive becomes filled, thus depriving the queen of opportunity to lay eggs, and of necessity depleting the colony. This might be called ruinous prosperity.

The natural use of the honey is to furnish the mature bees with food, and when mixed with pollen to form the diet of the young bees.

WAX.

The product of the bees second in importance is wax. As already remarked, this is a secretion, formed in pellets (Fig. 10, *a a*, etc.) underneath the abdomen. This wax is mixed with a sort of saliva in the bee's mouth, and after the proper kneading, is formed into that wonderful and exquisite structure, the comb. Honey-comb (Fig. 11), so wonderfully delicate, and so formed as to combine the greatest strength with the least expense of material, has been a subject of admiration since the earliest time. The character of the cells, whether drone or worker, seems to be determined by the relative abundance of bees and honey. If the bees are abundant and honey needed, or if there is no queen to lay eggs, drone comb (Fig. 11, below to the left), is invariably built, while if there are few bees, and of course little honey needed, then worker comb (Fig. 11, above and to right), is almost as invariably formed.

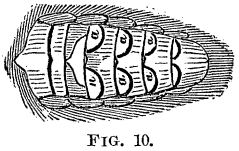

FIG. 10.

All comb when first formed is clear and transparent. The fact that it is often dark and opaque implies that it has been long used as brood-comb, and the opacity is due to the innumerable thin cocoons which line the cells. Such comb need not be discarded, for if composed of worker-cells, it is still very valuable for breeding purposes, and should not be destroyed till the cells are *too* small for longer service, which will not occur till after many years of use.

The function then of the wax is to make comb and caps for the honey cells, and, combined with pollen, to form queen cells (Fig. 11, 1, 2, 3, 4, and 5) and caps for the brood cells.

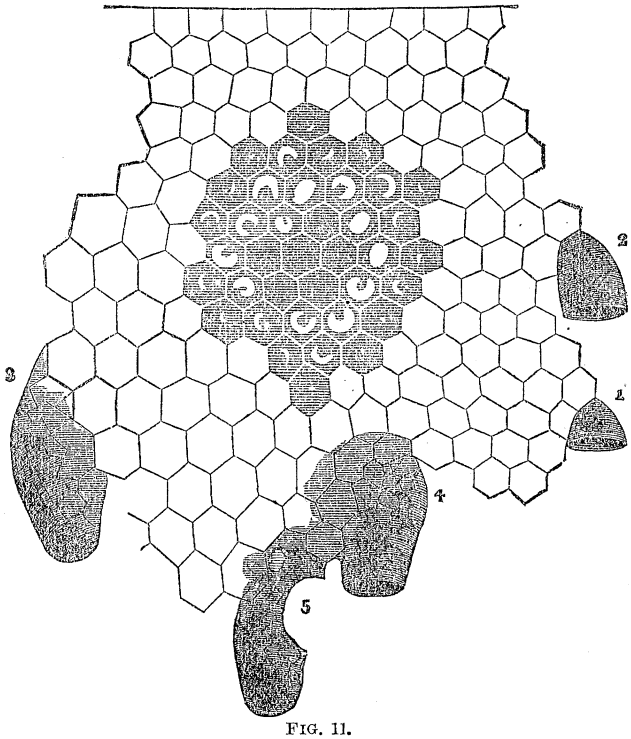

FIG. 11.

The comb furnishes cells for the storage of honey, and in which to rear brood.

POLLEN OR BEE-BREAD.

This substance, like honey, is not secreted, nor manufactured by the bees, only collected. The bees usually obtain it from the stamens of flowers. But if they gain access to flour when there is no bloom, they will take this in lieu of pollen, in which case the former term used above becomes a misnomer, though usually the bee-bread consists almost wholly of pollen.

As already intimated, the pollen is conveyed in the pollen baskets of the posterior legs, to which it is conveyed by the other legs, and compressed into little oval masses. The motions in this conveyance are exceedingly rapid. The bees not infrequently come to the hives, not only with replete pollen baskets, but with their whole under surface thoroughly dusted. Dissection will also show that the same bee may have her sucking stomach distended with honey. Thus the bees make the most of their opportunities. It is a curious fact that the bees, during any trip, gather only a single kind of pollen, or only gather from one species of bloom. Hence, while different bees may have different colors of pollen, the pellets of bee-bread on any single bee will be uniform in color throughout. It is possible that the material is more easily collected and compacted when homogeneous.

The pollen is usually deposited in the small or worker cells, and is unloaded by a scraping motion of the posterior legs, the pollen baskets being first lowered into the cells. The bee thus freed leaves the wheat-like masses thus deposited to be packed by other bees. The cells, which may or may not have the same

color of pollen throughout, are never filled quite to the top, and not infrequently the same cell may contain both pollen and honey, Such a condition is easily ascertained by holding the comb between the eye and sun. If there is no pollen it will be wholly translucent; otherwise there will be opaque patches. A little experience will make this determination easy, even if the comb is old. It is often stated that queenless colonies gather no pollen, but this is not true, though very likely they gather less than they otherwise would. It is probable that pollen, at least when honey is added, contains all the essential elements of animal food. It certainly contains the very important principle, which is not found in honey: nitrogenous material.

The function of bee-bread is to help furnish the brood with proper food. In fact, brood-rearing would be impossible without it. And though it is certainly not essential in the nourishment of the bees themselves, it still may be so in time of wax secretion.

PROPOLIS.

This substance, also called bee-glue, is collected, not made nor secreted. It is the product of various resinous buds, and may be seen to glisten on the opening buds of the hickory and horse-chestnut, where it frequently serves the entomologist by capturing small insects. From such sources, from the oozing gum of various trees, from varnished furniture, and from remaining propolis about unused hives, that have previously seen service, do the bees secure their glue. This substance has great adhesive force, and though soft and pliable when warm, it becomes very hard and unyielding when cold.

The use of this substance is to cement, to fill up all rough places inside the hive, to seal up all crevices except the place of exit, and even to cover any foreign substance that cannot be removed. Intruding snails have thus been imprisoned inside the hive.

CHAPTER VI.

THE RACES OF BEES.

There are three races or breeds of the species Apis mellifica, viz.: The Egyptian, German or black, and the Italian or Ligurian.

As the Egyptian bee is not kept either in Europe or our own country, and as I have no authentic description of its habits or character, I will only dwell on the other races.

GERMAN BEES.

These are the common bees of Europe, and were those first imported to our country, and so became common here. The queen and drones are of a deep black hue, while the neuters are more obscure, though still black, with a very slight grayish cast. As these are so well known, I will not stop to consider their habits, but wait and contrast them in this respect with the Italians.

ITALIAN BEES.

These bees take their name from the fact that they were first discovered in the mountain basin of northern Italy and Switzerland, shut in, as it were, by

the Alps. Without much doubt they are a climatic variety, with characters of coloration and habits so inbred that they are a fixed race. It may be, as has been asserted, that the original stock was a cross between the black and the Egyptian races. The queen varies much in color. She may be almost entirely yellow, is rarely almost as black as the German queen, but is generally irregularly marked with black and yellow. The drones are also black, annulated, or spotted with yellow, while the neuters will without exception, if the stock is pure, possess three yellow bands about the base of the abdomen. I repeat, every bee in the colony must be thus marked. The first ring is close to the thorax, and very narrow. The second is quite broad. These two rings are usually quite distinct in hybrids. The third ring is narrower, and may be obscured in old bees, especially if not distended with honey. When this ring is absent in any of the bees there is "something rotten in Denmark."

The able agricultural editor of one of our leading State papers has unwisely invaded the apiary in one or two editorials; and, wise beyond what is written, has stated that the Italians were in no wise superior to the black bees; and, further, that this point was conceded by all disinterested apiarists. He might as well say that a Duchess among Short-horns was in no wise superior to the lean, bony kine of Texas; or that our Essex and Berkshire swine are no whit better than the cadaverous lank breeds, with infinite noses, that happily are now so rare among us. The Italians are *far* superior to the German bees in many respects, and more,—though I am acquainted with all the works on apiculture printed in our language, and have an extensive acquaintance with the leading apiarists of our country from Maine to California, yet I know of only one man who holds that the Italians are no better than the Germans, and he is proverbial for opposing any and every thing which any other person may present. I have yet to conceive how so able, careful, and conscientious a writer could have been so misled as to make so glaring and mischievous an error.

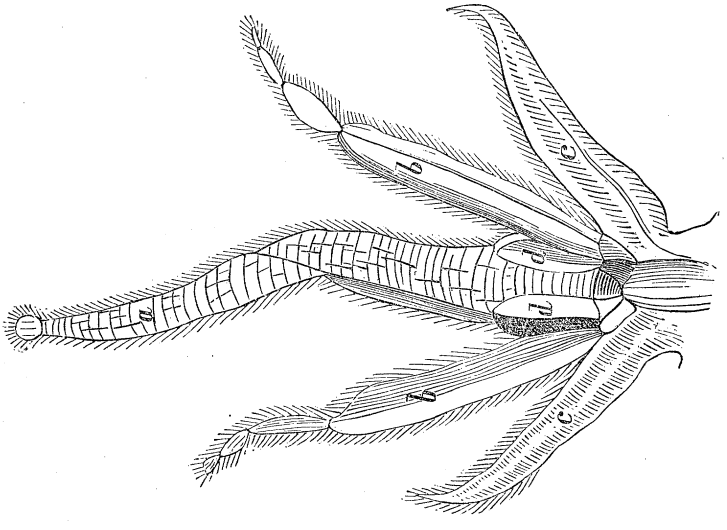

FIG. 12.

Italian worker's mouth parts; *a*, tongue; *b*, labial palpi; *c*, mandibles; *d*, paraglossæ. A **black worker** bee's tongue compared with this would reach only to *a* by accurate measurement.

The Italians certainly possess the following points of superiority:

First, They possess longer tongues (Fig. 12), and so can gather from flowers which are useless to the black bee.

Second, They are more active, and with the same opportunities will collect a good deal more honey.

Third, They work earlier and later.

Fourth, They are far better to protect their hives against robbers. Robbers that attempt to plunder Italians of their hard-earned stores soon find that they have "dared to beard the lion in his den."

Fifth, They are almost proof against the ravages of the bee-moth's larvæ.

Sixth, The queens are decidedly more prolific. This is probably in part due to the greater and more constant activity of the neuters.

Seventh, Brood-rearing commences earlier in the season.

Eighth, The queen is more readily found, which is a great advantage.

Ninth, The bees are more disposed to adhere to the comb while being handled, which some might hold as a doubtful compliment, but which I consider a desirable quality.

Tenth, They are far less apt to attempt to rob other hives.

Eleventh, And in my estimation, a sufficient ground for preference, did it stand alone, the bees are *far more* amiable. Years ago I got rid of my black bees, because they were so cross. This year I got two or three colonies, that my students might see the difference, but to my regret; for, come to remove the honey this autumn, they seemed perfectly furious, like demons, seeking whom they might devour, and this, too, despite the smoker, while the far more numerous Italians were safely handled, even without smoke. The experiment at least satisfied a large class of students as to superiority. No, I have kept these two races side by side for years, I have studied them most carefully, and I know that none of the above eleven points of excellence are too strongly stated.

The black bees are superior in one, and in perhaps two respects. They certainly will go into boxes more readily, to make box-honey, and I have some reason to think that they are more hardy, yet many claim that the Italians are superior in point of hardiness.

CHAPTER VII.

WHAT CONDITIONS ARE REQUISITE TO ENSURE THE GREATEST ACCOMPLISHMENTS IN THE APIARY.

The most important demand, in fact, it is the very key to all success, is, that the bees be kept strong. This fortifies against robbers, is an impregnable wall of defense against the bee-moth, helps to make the apiarist merry despite the disastrous winters, and insures a yield of precious nectar, which makes glad the heart, and full the pocket.

This demands, of course, that if swarming be allowed at all, such swarms should be secured, and that excessive swarming be prevented. It also demands that the queen should never cease laying for want of room, or empty cells in

which to deposit. That the workers should not have too long intervals of idleness, even though flowers are wanting or fail to yield honey, for as we have seen idleness of the queen follows, and of course depletion of worker bees. That colonies should never be queenless, or at least that such a condition should be very rare, and very brief; that colonies should be increased so as to involve the least loss, and least disturbance; that storing should never cease for want of room in which to store; that indolence should never be necessitated from a too high temperature inside the hive; that the bees should be in a locality where honey plants are abundant; that the bees should be so wintered as not to dwindle; that foul-brood should be known and prevented; that only the best bees should be kept; and, last, but perhaps most important of all, that the hives, though cheap and simple, should be so constructed as to secure honey in the most desirable condition, and admit the most free and easy access to the bees, so that the apiarist may know the exact condition of all his colonies at all times, and be able to administer timely aids whenever circumstances shall require it.

TO SECURE NATURAL SWARMS.

To prevent anxiety and constant watching, and to secure a more equable division of bees, and as I know more honey, it is better to provide against natural swarming entirely by use of means which will appear in the sequel. But as this requires some experience, and as often through neglect, either necessary or culpable, swarms may issue, every apiarist should be ever ready with both means and knowledge for immediate action. The means are good hives in readiness, a good jack-knife, some kind of a brush—a turkey wing will do—and a bag or basket, with ever open top, which should be at least eighteen inches in diameter, and this receptacle so made that it may be attached to the end of a pole. Two such poles, one very long, and the other shorter, and either a sheet, or light thin board platform, three by five feet, planed and strengthened by cross strips.

Now let us attend to the method: As soon as the cluster commences to form, place the sheet or platform on the ground near by, with the hive upon it, near one end. The side of the hive facing the vacant space, of either platform or sheet, should be raised a half inch, by inserting two blocks underneath, so the bees can have a good chance to enter. As soon as the bees are fully clustered, we must manage as best we can to empty the whole cluster in front of the hive. As the bees are full of honey we need have little fear of stings. Should the bees be on a twig that could be sacrificed, this might be easily cut off with either the knife or saw, and so carefully as hardly to disturb the bees; then carry and shake the bees in front of the hive, when with joyful hum they will at once proceed to enter. If the twig must not be cut, shake them all into the basket, and empty before the hive. Should they be on a tree trunk, or a fence, then brush them with the wing into the basket, and proceed as before. If they are high up on a tree, take the pole and basket, and perhaps a ladder will also be necessary.

Always let ingenuity have its most perfect work, not forgetting that the object to be gained is to get just as many of the bees as is possible on the platform in front of the hive. Carelessness as to the quantity might involve the loss of the queen, which would be serious. The bees *will not* remain unless the queen enters the hive. Should a cluster form where it is impossible to brush or shake them off, they can be driven into a basket, or hive, by holding it above them

and blowing smoke among them. As soon as they are nearly all in—a few may be flying around, but if the queen is in the new hive they will go back to their old home—remove the hive to its permanent stand. All washes are useless, it is better that the hive be clean and pure. In such, if they are shaded, bees will scarcely ever leave. But assurance will be made doubly sure by giving them a frame of brood, in all stages of growth, from the old hive. This may be inserted before the work of hiving is commenced.

HOW TO PREVENT SECOND SWARMS.

In the sequel it will appear that the wise apiarist will always have on hand extra queens. Now, if he does not desire to form nuclei (in manner to be explained), and thus use these queen cells, he will at once cut them *all* out, and destroy them, and give the old colony a fertile queen. The method of introduction will be given hereafter, though in such cases there is very little danger of giving them a queen at once. And by thoroughly smoking the bees, and sprinkling with sweetened water, and daubing the new queen with honey, we may be almost sure of success. If desired, the queen cells can be used in forming nuclei, in manner to be hereafter described. In this way we save our colony from being without a fertile queen for at least thirteen days, and that, too, in the very height of the honey season, when time is money. If extra queens are wanting, we have only to look carefully through the old hive and remove all but one of the queen-cells. A little care will certainly make sure work, as, after swarming, the old hive is so thinned of bees, that only carelessness will overlook queen-cells in such a quest.

HOW TO SECURE EMPTY CELLS FOR THE QUEEN, EVEN IN TIMES OF THE GREATEST HONEY-HARVEST.

Although some of our most experienced apiarists say nay, it is nevertheless a fact, that the queen often remains idle, or extrudes her eggs only to be lost, simply because there aré no empty cells. The honey yield is so great that the workers occupy every available space, and sometimes even they become unwilling idlers simply because of necessity. Seldom a year has passed but that I have noticed some of my most prolific queens thus checked in duty. And when I have relieved such queens from this state of enforced idleness they have always showed an activity which seemed at least to betoken great warmth of gratitude. In such cases the apiarist finds an invaluable aid in the

HONEY EXTRACTOR.

No doubt that some have expected and claimed too much for this machine. It is equally true that some have blundered quite as seriously in an opposite direction. For since Mr. Langstroth gave the movable frame to the world, the apiarist has not been so deeply indebted to any inventor as to him, who gave us the principle of the Mell Extractor Herr Von Hruschka, of Germany. Even if there was no sale for extracted honey,—aye, more, even if it must be thrown away, which will never be necessary, as it may always be fed to the bees with profit, even then I would pronounce the extractor as invaluable to every bee-keeper.

WHAT STYLE TO BUY.

The machine should be as light as is consistent with strength. It is best that the can be stationary and that only a light frame be made to revolve with the

comb. It is desirable that the machine should run with gearing, not only for ease, but also to insure or allow an even motion, so that we need not throw even drone larvæ from the brood cells. The arrangement for exit of the honey should permit a speedy and perfect shut-off.

WHEN TO USE THE EXTRACTOR.

If extracted honey can be sold for twenty, or even fifteen cents, the extractor may be used profitably the summer through; otherwise use it sufficiently often that there may always be empty worker cells in the brood chamber.

It is thus required with us during the two great honey harvests,—the white-clover and bass-wood. I have always extracted the honey at such times before it was capped, in fact, as fast as the cells were filled, and never yet found it so thin that it was not agreeable and wholesome. If it granulates it can be reduced with no injury to fluid again by heating, which is best done by placing the vessel containing it in boiling or heated water. When once brought to a boiling temperature it will seldom granulate again if kept in a dark place.

Many bee-keepers will be able to create a demand for their extracted honey. Those who cannot will find it very advantageous to feed it to their bees, at times, and in the manner described in what follows.

HOW TO INSURE CONTINUOUS BREEDING.

As already stated it is only when the worker bees are storing that the queen deposits to the full extent of her capability, and that brood-rearing is at its height. In fact, when storing ceases, general indolence characterizes the hive. Hence, if we would achieve the best success, we must keep the workers active, even before, and in the interims of honey secretion by the flowers, and to do this we must feed sparingly before the advent of bloom in the spring, and whenever the neuters are forced to idleness during any part of the season, by the absence of honey-producing flowers. For a number of years I have tried experiments in this direction by feeding a portion of my colonies early in the season, and in the intervals of honey-gathering, and always with marked results in favor of the practice. The past season three of our students tried similar experiments, between the bass-wood bloom and the fall flowers, and with as striking evidence in favor of the practice. Early feeding also fills the necessary space in the brood chamber, so that at the dawn of the white clover era, the delicious nectar then gathered will, of necessity, be stored in the boxes or frames set apart for this delightful harvest.

HOW MUCH TO FEED.

In such cases the amount fed need not be great. A half pound a day, or even less, will be all that is necessary to encourage the bees to active preparation for the good time coming.

WHAT TO FEED.

For this purpose I would feed coffee A sugar, reduced to the consistency of honey, or else extracted honey kept over from the previous year. The price of the latter will decide which is most profitable. Many advise feeding the poorer grades of sugar in spring. My own experience makes me question the policy of ever using such feed for bees.

HOW TO FEED.

The feeder (Fig. 13) which I have used with the best satisfaction is much the

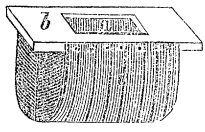

FIG. 13.

form of a frame of comb with the lower half cut off. The top bar (*b*, Fig. 13) is two inches wide and one-half inch thick, with a central hole (*c*, Fig. 13) one inch wide by three long. Tacked to the edge of this top-bar is a bag made of drilling, which should not reach nearer the ends than one inch, and should not be more than half as deep as the hive. This is put into a hive either at the end or between the frames. If at the end and a quilt is used to cover the frames the quilt need not extend over the feeder, but tuck in closely beside it, thus precluding any bees gaining entrance to the feeder. If it is placed between other frames the quilt should be stuck to the top bar of the feeder, and a hole or flap cut in it immediately above the hole in the bar. If a honey board is used, the bar of the feeder can be fastened to the honey board, with the hole immediately beneath the same in the honey board. Now, to feed we have only to raise the top of the hive, and with a tin pail with a long spout turn in our feed. As the bees can not get above they cause us no trouble. And the feeding becomes a matter of great ease and rapidity. The drilling should be just fine enough to permit the syrup to ooze through. I have even used very closely woven unbleached factory. These feeders can be washed out when not in use, and can be used for feeding whenever it is desired, for whatsoever purpose.

COLONIES SHOULD NEVER BE QUEENLESS.

Suppose the queen is laying 2,000 eggs a day, and that the full number of bees is 40,000, then it will be seen that each day that a colony is without a queen there is a loss equal to one-twentieth of the working force of the colony, and this is a compound loss, as the aggregate loss of any day is its special loss, augmented by the several losses of previous days. Now, as queens are liable to die, to become impotent, and as the act of increasing colonies demand the absence of queens, unless the apiarist has extra ones at command, it is imperative, would we secure the best results, to ever have at hand extra queens.

HOW TO REAR QUEENS.

As queens may be needed by the last of May, preparations looking to the early rearing of queens must commence early. When preparing the colonies for winter the previous autumn, be sure to place some drone comb somewhere near the centre of the colony that has given the best results the previous season. In March, and certainly by the first of April, see that all colonies have plenty of bee-bread. If necessary, place unbolted flour, rye is best, in shallow troughs near the hives. It will be well to give the whole apiary the benefit of such feeding before the flowers yield pollen, but the colony under consideration should be given frames containing bee-bread which was stored the previous year. At the same time, March or April, commence stimulative feeding. If you have another colony equally good with the first, also give that the pollen, and commence giving it feed, but only worker comb should be in the brood chamber. Very likely in April drone eggs will be laid in the drone comb. I have had drones flying the first of May. As soon as the drones commence to hatch out remove the queen. If two equally good colonies are being fed, remove the queen from the one that is without drone comb. This queen may be used in making a new colony, in manner soon to be described under artificial swarming, or increasing the number of colonies. This queenless colony will immediately commence forming queen cells. (Fig. 11.) Sometimes these are formed to the number of fifteen or twenty, and they are started, too, in a full vigorous colony,

in fact, under the most favorable conditions. Cutting off edges of the comb, or cutting holes in the same where there are eggs or larvæ just hatched, will almost always insure the starting of queen cells in such places. There is one disadvantage in this course which would not have been true had the bees been left till they prepared to swarm: the queens are almost sure to be started from worker larvæ two or three days old, yet if left till preparation for swarming was made, the number of queen cells is apt to be very small. We could wait, at quite an expense of time, and after six days cut out all queen cells then started, and insert fresh eggs from our favorite queen, and remedy both evils. If this is deemed best, we can cut out small pieces of comb, containing eggs or larvæ just hatched, and insert in holes cut in the brood comb of the colony where we are to rear our queens. Thus we meet every possible requisite for raising the most superior queens. In fact, we exercise a care in our breeding that even the best horse or cattle breeders cannot surpass. In a week these cells are capped, and the apiarist is ready to form his

NUCLEI.

A nucleus is simply a miniature colony of bees—a hive and colony on a small scale, for the purpose of rearing and keeping queens. We want the queens, but can afford to each nucleus only a few bees. The nucleus hive, if we use frames not more than one foot square, need be nothing more than an ordinary hive, with chamber confined by a division board (see section on hives) to the capacity of three frames. If our frames are large, then we shall be obliged to construct special nucleus hives. These are small hives, need not be more than six inches each way, that is, in length, breadth, and thickness, and made to contain from four to six frames of corresponding size. These frames are filled with comb. I have for the last two or three years used the first named style of nucleus hive, and have found it advantageous to have about two long hives made, each to contain five chambers, each of which is entirely separate from the one next to it, and five inches wide. Each chamber is covered by a separate, close-fitting board, and the whole by a common cover. The entrance for the two end chambers is at the ends near the same side of the hive. The middle chamber has its entrance at the middle of the side near which are the end entrances, while the other two chambers open on the opposite side, as far apart as is possible. The outside might be painted different colors to correspond with the divisions, if thought necessary, especially on the side with two openings. Yet I have never taken this precaution, nor have I been troubled by losing queens. They have invariably entered their own apartments when returning from their wedding tour. These hives I use to keep queens during the summer. In spring I make use of my hives which are prepared for prospective summer use, for my nuclei. Now go to different hives of the apiary, and take out three frames for each nucleus, at least one of which has brood, and so on, till there are as many nuclei prepared as you have queen cells to dispose of. The bees should be left adhering to the frames of comb, only we must be certain that the queen is not among them, as this would take the queen from where she is most needed, and would lead to the sure destruction of one queen cell. I usually shake off into the nucleus the bees from one or two more frames, so that, even after the old bees have returned, there will still be a sufficient number of young bees left in the nucleus to keep the temperature at a proper height. If any desire the nuclei with smaller frames, these frames must of course be filled with comb, and then we can shake bees immediately into the nuclei, as given above, till they shall have sufficient to preserve a proper temperature. In this case the queen cell

should be inserted just before the bees are added; in the other case, either before or after. To insert the queen cell—for we are now to give one to each nucleus, so we can never form more nuclei than we have capped queen cells—we first cut them out, commencing to cut on either side the base of the cell, at least one-half inch distant, *we must not in the least compress the cell*, then cutting up and out for two inches, then across opposite the cell. This leaves the cell attached to a wedge-shaped piece of comb, whose apex is next the cell. A similar cut in the middle frame of the nucleus, which in case of the regular frames, is the one containing brood, will furnish an opening to receive the wedge containing the cell. The comb should also be cut away beneath so that the cell cannot be compressed. After all the nuclei have received their cells and bees, they have only to be set in a shady place and watched to see that sufficient bees remain. Should too many leave, give them more by removing the cover and shaking a frame loaded with bees over the nucleus; keep the opening nearly closed, and cover with a quilt. The main caution in all this *is to be sure not to get any old queen in a nucleus.* In two or three days the queens will hatch, and in a week longer will have become fertilized, and that, too, by selected drones, for as yet there are no other in the apiary, and the apiarist will possess from ten to thirty-five queens, which will prove his best stock in trade. I cannot overestimate the advantage of ever having extra queens. By keeping empty frames and empty cells in the nuclei, the bees may be kept active, yet with so few bees one cannot expect very much of them. After cutting all the queen cells from our old hive, we can again insert eggs and obtain another lot of cells, or if we have a sufficient number, we can leave a single queen cell, and this colony will soon be the happy possessor of a queen, and just as flourishing as if the even tenor of its ways had not been disturbed.

HOW TO MULTIPLY COLONIES WITH THE BEST RESULTS.

We have already seen the evils of natural swarming, which, even though no stock is too much reduced in numbers, no colony lost by not receiving prompt attention, no Sunday quiet disturbed, and no time wasted in anxious watching, yet, at best, the old colony is queenless for about two weeks, *a state of things which no apiarist can or should afford.* The true policy, then, is to practice

ARTIFICIAL SWARMING.

This method of procedure will divide evenly, will increase our number of colonies just to our liking, and with the least possible disturbance, will prevent loss of time, and is in every respect safer and to be preferred to natural swarming. I have practiced artificial swarming ever since keeping bees, and *never without the best results.*

HOW TO DIVIDE.

By the process already described, we have secured a goodly number of fine queens, which will be in readiness at the needed time. Now, as soon as the white clover harvest is well commenced, early in June, we may commence operations. If we have but one colony to divide, it is well to wait till they become pretty populous, but not till they swarm. Take one of our waiting hives, which now holds a nucleus and fertile queen, and remove the same close along side the colony we wish to divide. This must only be done on warm days when the bees are active, and better be done while the bees are busy, in the middle of the day. Remove the division board of the new hive, and then remove five combs, well loaded with brood, and of course containing some honey, from the old colony, bees and all, to the new hive. Also take the remaining frames and shake the bees into the new hive. *Only be sure that the queen still remains in the old hive.*

Fill both the hives with empty frames, and return the new hive to its former position. The old bees will return to the old colony, while the young ones will remain peaceably with the new queen. The old colony will now contain at least seven frames of brood, honey, etc., the old queen, and plenty of bees, so that they will work on as though naught had transpired, though perhaps moved to a little harder effort by the added space and five empty frames. The empty frames may be all placed at one end, or placed between the others, though not so as to divide brood. The new colony will have eight frames of brood, comb, etc., three from the nucleus and five from the old colony, a young fertile queen, plenty of bees, those of the previous nucleus and the young bees from the old colony, and will work with a surprising vigor, often even eclipsing the old colony.

If the apiarist has several colonies, it is better to make the new colony from several old colonies, as follows: Take one frame of brood comb from each of six old colonies, or two from each of three, and carry them, bees and all, and place with the nucleus. *Only,* be sure that no *queen is removed.* Fill all the hives with empty frames, as before. In this way we increase without in the least disturbing any of the colonies, and may add a colony every day or two, or perhaps several, depending on the size of our apiary, and can thus always, so my experience says, prevent swarming. These are unquestionably the best methods to divide, and so I will not complicate the subject by detailing others. The only objection that can be urged against them is that we must seek out the queen in each hive, or at least be sure that we do not remove her, though this is by no means so tedious if we have Italians, as of course we all will. I might give methods which would render unnecessary this caution, but they are inferior, and not to be recommended. If we proceed as above described, the bees will seldom prepare to swarm at all, and if they do they will be discovered in the act, by such frequent examinations, and the work may be cut short by at once dividing such colonies as first explained, and destroying their queen cells, or, if desired, use them for forming new nuclei.

HOW TO HANDLE BEES.

But, says one, Shall we not be stung to death? *No one* need be stung. Bees should never be jarred, nor irritated by quick motions. Those with nervous temperaments—and I plead very guilty on this point—need not give up, but at first better protect their faces, and perhaps even their hands, till time and experience show them that fear is vain; then they will divest themselves of all such useless encumbrances.

THE BEST BEE-VEIL.

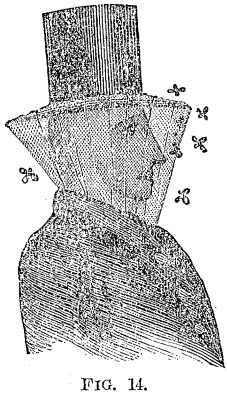

FIG. 14.

This should be made of black tarlatan, sewed up like a bag, a half yard long, and with a diameter of the rim of a common straw hat, without top or bottom. Gather the top with braid, so that it will just slip over the crown of the hat, and the bottom with rubber cord or rubber tape, so that it may be drawn over the hat rim, and then over the head as we adjust the hat. When in use (Fig. 14), the rubber cord draws the lower part close about the neck, and we are safe. This kind of a veil is cool, does not impede vision at all, and can be made by any woman at a cost of less than twenty cents. Common buckskin or sheepskin gloves can be used, as it will scarcely pay to get special gloves for the purpose, for the most timid person,—I speak from experience,—will soon consider gloves as an unnecessary nuisance.

TO QUIET BEES.

In harvest seasons the bees, especially if Italians, can almost always be handled without their showing resentment. But at other times, and whenever they object to necessary familiarity, we have only to cause them to fill with honey to render them harmless, unless we pinch them. This can be done either by closing the hive, so that they cannot get out, and then rapping on the hive for four or five minutes. Those within will fill with honey, those from without will be tamed by surprise, and all will be quiet. Another method, more convenient, is to smoke the bees. A little smoke blown among the bees will scarcely ever fail to quiet them, though I have known black bees in autumn to refuse to yield. Dry cotton cloth, closely wound and sewed or tied, or, better, pieces of dry rotten wood, are excellent for purposes of smoking. These are easily handled and will burn for a long time. But best of all is a

QUINBY SMOKER.

This is a tin tube attached to a bellows. Cloth or rotten wood can be burned in the tube, and will remain burning a long time. The smoke can be directed at pleasure, the bellows easily worked, and the smoker used without any disagreeable effects or danger from fire. It can be got of any dealer in bee apparatus, and only costs $1.50. I most heartily recommend it to all. It was patented by the late Mr. Quinby, to whom American bee-keepers are so greatly indebted, and I think he reserved the entire right to manufacture.

ROOM FOR STORING SHOULD ALWAYS BE PROVIDED.

Every apiarist has observed with uneasiness the frequent clustering of the bees outside the hive, in strange indolence, even when every flower is fragrant with sweet. A prolific cause of such expensive idleness is a too confined space within the hive, and no room for further storing. The evil may be prevented or removed in three ways:

First—By dividing the bees as already described, we shall remove a portion of the bees, give empty frames, and by removing the cause, prevent or overcome the evil.

Secondly—We may give more room for storing by using the extractor, whenever extracted honey is profitable, and as we have already seen, we must do this if the queen has not room for egg-laying.

Thirdly—We can add more frames, either at the side or above, as our hive permits (see section on hives), or add surplus honey boxes if we desire our surplus in comb and in the best form to suit the market.

IN WHAT FORM TO SECURE OUR SURPLUS COMB HONEY.

As before stated, if we can get fifteen or twenty cents for extracted honey, we shall not care to work for that in the comb, and only allow surplus in those drone combs, a few of which will steal in, despite the most wary apiarist. Otherwise we will arrange for comb-honey. This will be most readily and abundantly secured in frames, which may be suspended at the side of, or above, the brood frames. These frames may be the usual size, or half, or quarter size. The method of construction will be described in the sequel. The objection that some urge to this arrangement is, that the frame honey does not meet such ready sale or receive as high prices as that in boxes, yet the retail dealers in Lansing prefer it. Whether the extra amount will compensate for the lower

price must be decided by each apiarist, as it will depend wholly on the locality. If boxes are preferred, they should be so made as to best attract the buyer, and put in place as soon as the brood chamber is well filled, which, with proper management, will be at the opening of the white clover harvest. As soon as storing ceases, the boxes or frames should be removed, as the comb will keep brighter, and the boxes freer from bee-glue. If not full they can be returned as storing is resumed. To free the boxes of bees when removed, they should be placed in a close box, which should be all covered from the light except one little opening, and through this the bees will escape to their hive. Should robbers enter, leave the large box uncovered except by a thin sheet, which can be turned over as the bees collect on it.

Boxes containing honey should be placed in dry, cool rooms, secure from mice and moths, and it would be well to place them in a close box the third day after their removal from the hive, and burn some sulphur in the box. The fumes would do no injury to the honey, and would destroy any inchoate moths. (The methods of making, preparing, and adjusting boxes will be described under hives.)

HIVES SHADED.

Bees are also forced to cluster outside the hive, where the hives are subjected to the full force of the sun's rays. By the intense heat the temperature inside becomes like that of an oven, and the wonder is that they do not desert entirely. I have known hives thus unprotected to be covered by bees idling outside, when by simply shading the hives all would go merrily to work. The combs, too, are liable, in unshaded hives, to melt and fall down, which is very damaging to the bees, and very vexatious to the apiarist. The remedy for all this is to always have the hives so situated that they will be entirely shaded all through the heat of the day. This might be done by constructing a shed or house, but these are expensive and inconvenient, and therefore to be discarded. Perhaps the Coe house apiary may prove an exception; but, as yet, we have no reliable assurance of the fact. If the apiarist has a convenient grove, this may be trimmed high, so as not to be damp, and will fulfill every requirement. So arrange the hives that, though they are shaded through all the heat of the day, they will receive the early and late rays, and thus work more hours. I always face my hives to the east. If no grove is at command, the hives may be placed on the north of a Concord grape vine, or evergreen, which may soon be secured for the purpose. Norway spruce is the best. These should be at least six feet apart. A. I. Root's idea of having the vines of each succeeding row divide the spaces of the previous row, in quincunx order, is very good; though I should prefer the rows in this case to be four, instead of three feet apart, especially with evergreens. The same gentleman's idea of having sawdust under and about the hives is a good one. The hives of the Michigan Agricultural College are protected by evergreens, trimmed close on the north side. A space four feet by six, north of the shrubs, was then dug out to a depth of four inches, and filled with sawdust, underlying which were old bricks, so that nothing would grow up through the sawdust. The sawdust thus extends one foot back, or west of the hive, three feet north, and the same distance east, or in front. This makes it neat about the hive, and largely removes the danger of losing the queen in handling the bees; as should she fall outside the hive, the sharp-sighted apiarist would be very likely indeed to see her. Until protecting shade can be thus permanently secured, boards should be arranged for temporary protection. Many apiarists

economize by using fruit trees for this purpose, which, from their spreading tops, answer very well.

THE APIARY SHOULD BE IN MIDST OF HONEY PLANTS.

As bees do not make honey, but only gather it, and as honey is mainly derived from certain flowers, it of course follows that the apiarist's success will depend largely upon the abundance of honey-secreting plants in the vicinity of his apiary. True it is that certain bark and plant lice secrete a kind of liquid sweet—honey of doubtful reputation—which, in the dearth of anything better, the bees seem glad to appropriate. I have thus seen the bees thick about a large bark-louse which attacks the tulip tree, and thus often destroys one of our best honey trees. This is an undescribed species of the genus *Lecanium*. I have also seen them thick about three species of plant lice. One, the *Pemphigus imbricator*, Fitch, works on the beech tree. Its abdomen is thickly covered with long wool, and it makes a comical show as it wags this up and down upon the least disturbance. The leaves of trees attacked by this louse, as also those beneath the trees, are fairly gummed with a sweetish substance. I have found that the bees avoid this substance, except at times of extreme drouth and long protracted absence of honeyed bloom. It was the source of no inconsiderable stores during the terribly parched autumn of Chicago's great disaster. Another species of *Pemphigus* gives rise to certain solitary plum-like galls, which appear on the upper surface of the red elm. These galls are thin-skinned, and within the hollows are the lice, and their abundant sweet often attracts the bees, as to a feast of fat things, as the gall is torn apart, or cracks open, so that the sweet exudes. This sweet is anything but disagreeable, and may not be unwholesome to the bees. Another, black aphis, works on the branches of our willows, which they often entirely cover, and thus greatly damage another tree valuable for both honey and pollen. Were it not that they seldom are so numerous two years in succession, they would certainly banish from among us one of our most ornamental and valuable honey-producing trees. These are fairly thronged in September and October by bees, wasps, ants, and various two-winged flies, all eager to lap up the oozing sweets. This louse is doubtless the *Lachnus dentatus*, of Le Baron, and the *Aphis salicti*, of Harris. Bees also get, in some regions, a sort of honey-dew, which enables them to add to their stores with surprising rapidity. I remember one morning while riding on horseback along the Sacramento River, in California, I broke off a willow twig beside the road, when, to my surprise, I found it was fairly decked with drops of honey. Upon further examination I found the willow foliage was abundantly sprinkled by these delicious drops. These shrubs were undisturbed by insects, nor were they under trees. Here then was a real case of honey-dew, which must have been distilled through the night by the leaves. I never saw any such phenomenon in Michigan; still honey-dew may be a product even of our State. Has anyone undoubted evidence on the subject? Bees also get some honey from oozing sap, some of questionable repute from about cider mills, some from grapes and other fruit which have been crushed, or eaten and torn by wasps and other insects. That bees ever tear the grapes is a question of which I have failed to receive any personal proof, though for years I have been carefully seeking it. I have lived among the vineyards of California, and have often watched bees about vines in Michigan, but never saw bees tear open the grapes. I have laid crushed grapes in the apiary, when the bees were not gathering, and were ravenous for stores, which, when covered with sipping bees, were replaced with sound

grape clusters, which in no instance were mutilated. I have thus been led to doubt if bees ever attack sound grapes, though quick to improve the opportunities which the oriole's beak and the stronger jaws of wasps offer them. Still, Prof. Riley feels sure that bees are sometimes thus guilty, and Mr. Bidwell tells me he has frequently seen bees rend sound grapes, which they did with their feet. Yet, if this is the case, it is certainly of rare occurrence, and is more than compensated by the great aid which the bees afford the fruit-grower in the great work of cross-fertilization, which is imperatively necessary to his success, as has been so well shown by Dr. Gray and Mr. Chas. Darwin. It is true that cross-fertilization of the flowers, which can only be accomplished by insects, and early in the season by the honey-bee, is often, if not always necessary to a full yield of fruit and vegetables. Even then, if Mr. Bidwell and Prof. Riley are right, and the bee does, rarely—for surely this is very rare, if ever—destroy grapes, still they are, beyond any possible question, invaluable aids to the pomologist.

But the principal source of honey is still from the flowers.

WHAT ARE THE VALUABLE HONEY PLANTS?

In the northeastern part of our country the chief reliance for May is the fruit-blossoms, willows, and sugar maple. In June white clover yields largely of the most delicious honey, both as to appearance and flavor. In July the incomparable bass-wood makes both bees and apiarist jubilant. In August buckwheat offers its tribute, which we welcome, though it be dark, and pungent in flavor, while with us in Michigan, August and September give us a profusion of bloom which yields to no other in the richness of its capacity to secrete honey, and is not cut off till the autumn frosts,—usually about Sept. 15. Thousands of acres of golden rod, boneset, asters, and other autumn flowers of our new northern counties, as yet have blushed unseen, with fragrance wasted. This unoccupied territory, unsurpassed in its capability for fruit production, covered with grand forests of maple and bass-wood, and spread with the richest of autumn bloom, offers opportunities to the practical apiarist rarely equalled except in the Pacific States, and not even there, when other privileges are considered. In these localities two or three hundred pounds to the colony is no surprise to the apiarist, while even four or five hundred are not isolated cases.

In the following table will be found a list of valuable honey plants. Those in the first column are herbaceous or perennial, the herbaceous being enclosed in a parenthesis thus: () while those in the second are shrubs or trees, the names of shrubs being enclosed in a parenthesis. The date of commencement of bloom is, of course, not invariable. The one appended is about average for Central Michigan. Those plants whose names appear in small capitals yield very superior honey. Those with a line beneath are useful for other purposes than honey secretion. Those with a * are native or very common in Michigan. Those written in the plural refer to more than one species, while those followed by a † are very numerous in species. Of course I have not named all, as that would include some hundreds which have been observed at the college, taking nearly all of the two great orders Compositæ and Rosaciæ. I have only aimed to give the most important, omitting many foreign plants of notoriety, as I have had no personal knowledge of them:

DATE.	ANNUALS OR PERENNIALS.	DATE.	SHRUBS OR TREES.
May	* Strawberry	May	* (Willows.) †
May to June	* Dandelion.	"	* Maples—Sugar Maple.
June	* WHITE CLOVER.	"	* Crab Apple.
"	Catnip.	"	* Hawthorns.
"	Hoarhound.	"	* Fruit Trees. Apple, Plum, Cherry, Pear, etc.
"	* Mother-wort.	"	* (Currant and Gooseberry.)
"	ALSIKE CLOVER.	May to June	* Tulip-tree.
"	* Borage.	" "	* (Grape-vine.)
"	Sage.	June	* Wild-plum.
June to July	* Ox-eyed Daisy—bad weed.	"	* (Black Raspberry.)
" Aug.	* Bush Honeysuckle.	"	* Locusts.
" "	(MELILOT.)	"	* (RED RASPBERRY.)
" "	* Mustard. †	"	* (Sumach.) †
" "	Rape.	"	* Blackberry.
" Sept.	* St. John's Wort.	July	* BASS-WOOD.
July to Aug.	* Silk or Milk weeds.	"	* (Virginia Creeper.)
" "	* Boneset.	July to Sep.	(St. John's Worts.
August	* (Buckwheat.)		
"	* Asparagus.		
"	* Snap-dragon.		
Aug. to Sep.	* GOLDEN ROD. †		
" "	* Asters. †		
" "	* Stick-tights †—Coreopsis.		
" "	(Minnesota bee-plant) —Polanisia.		

HOW TO WINTER.

This is the subject, of course, of paramount importance to the apiarist, as this is the rock on which some of even the most successful have recently split. Yet I come fearlessly to consider this question, as from all the multitude of disasters I see no occasion for discouragement. If the problem of successful wintering has not been solved already, it surely will be, and that speedily. So important an interest was never yet vanquished by misfortune, and there is no reason to think that history is now going to be reversed. Even the worst aspect of the case, in favor of which there is no proof, and but few suggestions even, that these calamities are the effects of an epidemic, would be all powerless to dishearten men trained to reason from effect to cause. Even an epidemic—which would by no means skip by the largest, finest apiaries, owned and controlled by the wisest, most careful, and most thoughtful, as has been the case in the winters of our late discontent—would surely yield to man's invention.

WHAT THEN IS THE CAUSE?

Epidemic then, being set aside as no factor in the solution, to what shall we ascribe such wide-spread reverses. I fully believe, and to no branch of this subject have I given more thought, study, and observation, that all the losses may be traced either to unwholesome food, failure in late breeding of the previous year, extremes of temperature, or to protracted cold with excessive dampness. I know from actual and wide-spread observation, that the severe loss of 1870 and 1871 was attended in this part of Michigan with unsuitable honey in the hive. The previous autumn was unprecedentedly dry. Flowers were rare, and storing was largely from insect secretion, and the stores unwholesome. I tasted

of honey from many hives only to find it most nauseating. I fully believe that had the honey been thoroughly extracted the previous autumn, and the bees fed good honey or sugar, no loss would have been experienced. At least it is significant that all who did so, escaped, even where their neighbors all failed. Nor less so the fact that when I discovered eight of my twelve colonies dead, and four more just alive, I cleaned the remaining ones all out, and to one no worse nor better than the others I gave good capped honey stored early the previous summer, while the others were left with their old stores, that that one lived and gave the best record I have ever known, the succeeding season, while all the others died.

Again, suppose that after the bass-wood season in July, there is no storing of honey, either from want of space, or from lack of bloom. In this case brood-rearing ceases. Yet if the weather is dry and warm, as of course it will be in August and September, the bees continue to wander about, death comes apace, and by autumn the bees are reduced in numbers, old in days, and illy prepared to brave the winter and perform the duties of spring. I fully believe that if all the colonies of our State and country had been kept breeding by proper use of the extractor, and feeding even till into October, we should have had a different record, especially as to spring dwindling, and consequent death. In the autumn of 1872 I kept my bees breeding till the first of October. The following winter I had no loss, while my neighbors lost all of their bees.

Extremes of heat and cold are also detrimental to the bees. If the temperature of the hive becomes too great the bees become restless, eat more than they ought, and if confined to their hives are distended with their fœces, become diseased, besmear their comb and hives, and die. If when they become thus disturbed, they could have a purifying flight, all would be well.

Again, if the temperature becomes extremely low, to keep up the animal heat more food must be taken; they are uneasy, exhale much moisture, which may settle and freeze on the outer combs about the cluster, preventing the bees from getting the needed food, and thus in this case both dysentery and starvation confront the bees. I have little doubt, in fact I know from actual investigation that in the past three severe winters, those bees which under confinement have been subject to severe extremes, are the ones that have invariably perished. Had the bees been kept in a uniform temperature ranging from 35° to 45° F., the record would have been materially changed.

Excessive moisture, too, especially in cases of protracted cold, is always to be avoided. Bees, like all other animals, are constantly giving off moisture, which of course will be accelerated if the bees become disturbed, and are thus led to eat more. This moisture not only acts as explained above, but also induces fungus growths. The mouldy comb is not wholesome, though it may never cause death. Hence another necessity of sufficient warmth to drive this moisture from the hive and some means to absorb it without opening the hive above and permitting a current, which will disturb the bees, and cause the greater consumption of honey.

THE REQUISITE TO SAFE WINTERING.

To winter safely then demands that the bees have thirty pounds of good capped honey (coffee A sugar is just as good). If desired this may be fed as previously explained, which should be done so early that all will be capped during the warm days of October. I prefer too that some of the comb on the centre of the hive has empty cells, to give a better chance to cluster, and that all the combs have a small hole through the centre, that the bees may pass

freely through. This hole may simply be cut with a knife, or a tin tube the size of one's finger may be driven through the comb, and left in if desired, in which case the comb should be pushed out of the tube, and the tube be no longer than the comb is thick.

Keep the bees breeding till the first of October. Except in years of excessive drouth, this will occur in many parts of Michigan without extra care. Failure may result from the presence of worthless queens. Any queens which seem not to be prolific should be superseded whenever the fact becomes evident. *I regard this as most important.* Few know how much is lost by tolerating feeble, impotent queens in the apiary, whose ability can only keep the colony alive. Never keep such queens about. Here, then, is another reason for always keeping extra queens on hand. Even with excellent queens, a failure in the honey yield may cause breeding to cease. In such cases, we have only to feed as directed under the head of feeding.

We ought also to provide against extremes of temperature. If no cellar or house is at hand, this may be accomplished as follows: Some pleasant dry day in late October or early November raise the stand and place straw beneath; then surround the hive with a box a foot outside the hive, with movable top, and open on the east; or else have a long wooden tube, which will permit the bees to fly. The same end may be gained by driving stakes and putting boards around. Now crowd between the box and the hive either straw, chaff, or shavings. After placing a good thickness of straw above the hive, lay on the cover of the box, or cover with boards. This preserves against changes of temperature during the winter, and also permits the bees to fly if it becomes necessary from a protracted period of warm winter weather. I have thus kept all my bees safely during two of the disastrous winters.

With large apiaries the above method is too laborious, and a cellar or special depository is necessary. After my experience last winter, losing all my bees by keeping them in a house with double walls filled in with saw-dust, in which the thermometer indicated a temperature below zero for several weeks, in which time my strongest colonies literally starved to death in the manner already described, I hesitate to recommend a house above ground for Michigan, though with very numerous colonies it might do. Such a house must, if it answer the purpose, keep an equable temperature, at least 3° above freezing, and not more than ten, be perfectly dark, and ventilated with tubes above and below, so arranged as to be closed or opened at pleasure, and not admit a ray of light.

A cellar in which we are sure of our ability to control the temperature, needs to be also dry, dark, and quiet, and ventilated as described above. My cellar is grouted throughout, which makes it more dry and neat. Of course it should be thoroughly drained.

The colonies should be put into the depository when the hive is dry, before cold weather, and may remain with good results till April; though in January and March, if there are days that are warm, they should be taken out and the bees permitted to fly, especially if they seem uneasy and soil the entrance of their hives. *Always* when taken out they should be placed on their old stands, so that no bees may be lost. Towards night, when all are quiet, replace them in the cellar. In moving the hives, great care should be exercised not to jar them. It were better if the bees should not know that they were being moved at all.

That the moisture may be absorbed, I cover the bees with a quilt, made of coarse factory cloth, enclosing a layer of cotton batting. Above this I fill in with straw which is packed in so closely that the cover may be removed without

the straw falling out. This is not only an excellent absorbent, but preserves the heat, if allowed to remain, till the following June.

I have found it advantageous, when preparing my bees for winter, in October, to contract the chamber by use of a division board. This is very desirable if wintered out doors, and with frames a foot square is very easily accomplished. By use of eight frames the space (one cubic foot) is very compact, and serves to economize the heat, not only in winter, but in spring.

Perhaps I ought to say that all colonies should be strong in autumn. But I have said before, never have weak colonies. Yet for fear some have been negligent, I remark that weak colonies should be united in preparing for winter. To do this, approximate the colonies each day four or five feet till they are side by side. Now remove the poorest queen, then smoke thoroughly, sprinkle both colonies with sweetened water scented with essence of peppermint, putting a sufficient number of the best frames and all the bees into one of the hives, and then set this midway between the position of the hives at the commencement of the uniting. The bees will unite peaceably, and make a strong colony. Uniting of colonies may pay at other seasons. It may seem rash to some, yet I fully believe that if the above suggestions are carried out in full, I may guarantee successful wintering. But if we do lose our bees, with all our hives, combs, and honey, we can buy colonies in the spring, with a perfect certainty of making 300 or 400 per cent. on our investment. Even with the worst condition of things, we are still ahead, in way of profit, of most other vocations.

FOUL BROOD.

Just here it is very proper to speak of this dreaded disease. This disease, though it has occurred in our State as well as in States about us, is not familiar to me, I having never seen but one case, and that on Kelly's Island, the past summer, where I found it had reduced the colonies on that Island to two.

The symptoms are as follows: Decline in the prosperity of the colony, because of failure to rear brood. The brood seems to putrefy, becomes black and gives off a stench which is by no means agreeable, while later the caps have a little hole through them. So far, the cause is obscure, though the disease seems to be gendered by feeding upon the honey.

It is stated by some that transferring the bees to an empty hive, and preventing brood-rearing till all the honey conveyed in the bees' stomachs is consumed, is a cure. In this case the honey from the old hive must be kept from all the bees, or the spread of the disease will be certain. Others advise total destruction of affected colonies, honey, hives, and all. The disease is a very serious one, and the symptoms should be understood by all, that its spread may be prevented. More, the whole subject should be investigated by the most competent scientific authorities. What better work for the bee-keepers of our country than to memorialize Congress on this subject.

ALL SHOULD KEEP ONLY ITALIANS.

The advantages of the Italians, which have been already considered as fully as necessary, are more than sufficient to warrant the exclusion of any other bees from the apiary. Truly no one need to be urged to a course that adds to the ease, profit, and agreeableness of his vocation.

HOW TO ITALIANIZE.

From what has been already explained as to the natural history of bees, it will be seen that all we have to do to change our bees, is to change our queens.

Hence to Italianize a colony we have only to procure and introduce an Italian queen.

HOW TO INTRODUCE A QUEEN.

In dividing colonies, where we give our queen to a colony composed wholly of young bees, it is safe and easy to introduce a queen in manner as explained in the section on artificial swarming. To introduce a queen to a colony composed of old bees more care is required. First, we should seek out the old queen and destroy her, then cage our Italian queen in a wire cage, which may be made by winding a strip of wire cloth, three and one-half inches wide, and containing fifteen to twenty meshes to the inch, about the finger. Let it lap each way one-half inch, then cut it off. Ravel out the half inch on each side, and weave in the ends of the wires, forming a tube the size of the finger. We now have only to put the queen in the tube, and pinch the ends together, and the queen is caged. The cage may now be inserted between two adjacent combs containing honey, each of which will touch it. The queen can thus sip honey as she needs it. If we fear the queen may not be able to sip the honey through the meshes of the wire, we may dip a piece of clean sponge in honey and insert it in the upper end of the cage before we compress the end. This will furnish the queen with the needed food. In 48 hours we again open the hive, after a thorough smoking, also the cage, which is easily done by pressing the upper end, at right angles to the direction of the pressure when we closed it. In doing this do not remove the cage. Now keep watch and if as the bees enter the cage or as the queen emerges the bees attack her, secure her immediately and recage her for another 48 hours. I usually let some honey drip on the queen as soon as the cage is opened. Some think this renders the bees more amiable. I have introduced many queens in this manner, and never lost one, and never had to recage but one.

A young queen just emerging from a cell can almost always be safely given at once to the colony, after destroying the old queen.

A queen cell is usually received with favor. If we adopt this course we must be careful to destroy all other queen cells that may be formed; and if the one we supply is destroyed, wait seven days, then destroy all their queen cells, and they are sure to accept a cell. But to save time I should always introduce a queen.

If we are to introduce an imported queen, or one of very great value, we might make a new colony, all of young bees, as already described. Smoke them well, sprinkle with sweetened water, daub the queen with honey, and introduce immediately. This method would involve really no risk.

By having a colony thus Italianized in the fall, we may commence the next spring, and, as described in the section explaining the formation of artificial swarms, we may control our rearing of drones, queens, and all, and ere another autumn have only the beautiful, pure, amiable, and active Italians. I have done this several times, and with the most perfect satisfaction. I think by making this change in blood we add $5 to the value of each colony, and I know of no other way to make money so easy and pleasantly.

WHAT STYLE OF HIVES SHALL WE USE?

I feel free to say that no person who reads, thinks, and studies,—and success in apiculture can be promised to no other,—will ever be content to use the old box hives. In fact, thought and intelligence, which imply an eagerness to

investigate, are essential elements in the apiarist's character. And to such an one a box hive would be valued just in proportion to the amount of kindling-wood it contained. A very serious fault with one of our principal bee books which otherwise is mainly excellent in subject matter and treatment, is the fact that it presumes its readers are box-hive men. As well make emperors, kings, and chivalry the basis of good government, in an essay written for American readers. I have entirely ignored box-hives in the previous discussions, for I believe no sensible, intelligent apiarist, such as read books, will tolerate them, and that, supposing they would, it would be an expensive mistake, which I have no right to encourage, in fact, am bound to discourage, not only for the benefit of individuals, but also for the art itself.

For the movable frame hive, the world is indebted to the Rev. L. L. Langstroth, and for this gift, as well as his able researches in apiculture, as given in his invaluable book, "The Honey Bee," he has conferred a benefit upon our art which cannot be over-estimated, and for which we, as apiarists, cannot be too grateful. It was his book, one of my old teachers for which I have no word of chiding, that led me to some of the most delightful investigations of my life. It was his invention that enabled me to make those investigations. For one, I shall always revere the name of Langstroth, as the great leader in scientific apiculture, not only in America, but throughout the world. His name must ever stand beside that of Dzierzon and the elder Huber.

To be sure of success, the apiarist must be able to inspect the whole interior of the hive at his pleasure, must be able to exchange combs from one hive to another, to regulate the movements of the bees: by destroying queen cells, by giving or withholding drone comb, by extracting the honey, by introducing queens, and by many other manipulations already explained, which are only practicable with a movable frame hive.

CHARACTER OF THE HIVE.

The main feature of the hive should be simplicity, which would exclude doors, drawers, and traps of all kinds. The body should be made of good pine or white-wood lumber, one inch thick, thoroughly seasoned, and planed on both sides. It should be simply a plain box (Fig. 15) without top or bottom, though some prefer to have a bottom, and of a size and form to suit the apiarist. The size will depend upon our purpose. If we desire no comb honey, or desire comb honey in frames, the hive may contain 4,000 cubic inches. If we desire honey in boxes, it should not contain over 2,000, and may be even smaller. A one-inch rabbet should be cut from the top of the sides or ends, as the apiarist prefers, on the inside. (Fig. 15 *c*.) The rabbet may equal one-half the thicknes of the board. Heavy tin strips $\frac{3}{4}$ of an inch wide should be tacked to the side below the rabbet, so as to reach one-fourth of an inch above the shoulder. For a bottom board (Fig.

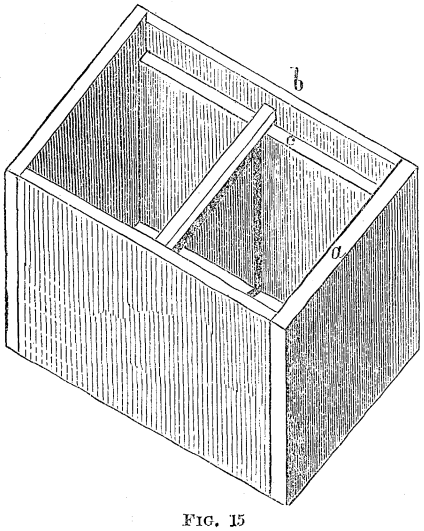

FIG. 15

16), or stand, we should have a single one-inch board (*b*, Fig. 16) four inches wider than the hive, and six inches longer. This is nailed on to two pieces of two-by-four-inch scantling (*a a* Fig. 16), thus raising the hive five inches from

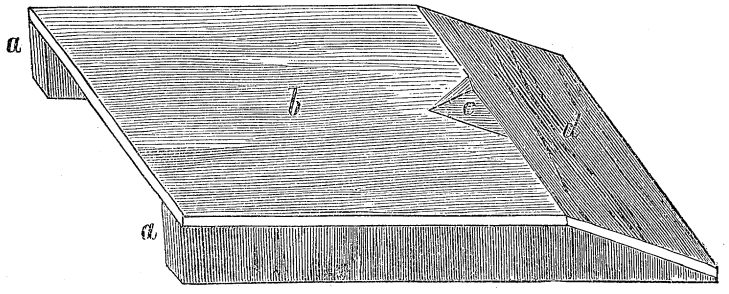

FIG. 16.

the ground. These scantling should extend at one end eight inches beyond the board, and this projection beveled from the edge of the board to the lower outer corner of the scantling. Upon this bevel nail a board (*d* Fig. 16), which shall reach from the edge of the bottom board to the ground. The upper edge of this board should be so beveled as to fit closely to the bottom board. For an opening (*c* Fig. 16) to the hive, I would bevel the middle of the edge of the bottom board, next to the inclined board. At the edge, this bevel should be $\frac{3}{4}$ of an inch deep and four inches wide. It may decrease in both width and depth as it runs back, till at a distance of five inches it is one-half inch wide and 5-32 of an inch deep. This may terminate the opening, though the shoulder at the end may be beveled off, if desired.

With this bottom board the bees are near the ground, and with the slanting board in front, even the most tired and heavily laden will not fail to gain the hive as they come in with their load of stores. *No hive should be more than four inches from the ground,* and no hive should be without the slanting alighting-board. With this opening, too, the entrance can be contracted in case of robbing, or entirely closed when desired, by simply moving the hive back. If desired, the alighting-board may be separate from the bottom board or stand, and fastened to it by small hooks and staples, so in winter they can be removed, and the hives take less room in the cellar.

If we only purpose to have our surplus in boxes, or if we prefer a long hive, styled the "New Idea," we have only to make a cover about seven inches high, like the lid of a trunk. This may be the same size as the body of the hive, and fit on with beveled edges, and fastened with hook and staple, the body of the hive having the outer edge beveled, while the cover has the inner edge beveled. Or it may be enough larger to shut over the body, and rest on shoulders formed by nailing inch strips around the body, two inches from the top. Some prefer the upper part to be just like the lower, and occupied by a similar frame. In this case the two should unite with a bevel, as explained above, while the cover may be as just described, except that it need not be more than two inches deep.

THE FRAMES.

The form and size of frames, though not quite as various as the persons who use them, are still very different. Some prefer large frames. I first used one 10 by 18 inches, and afterward a shallow frame about 7 by 18. The advantage

claimed for such large frames is that there are less to handle, and time is saved. The advantage of the shallow frame is, as claimed, that the bees will go into boxes more readily; yet they are not considered so safe for out-door wintering. Another frame in common use is one about one foot square. I use one $11\frac{1}{4}$ inches square. The reasons that I prefer this form are, that the comb seldom breaks from the frame, the frames are convenient for nuclei, and save the expense of constructing extra nucleus hives, and that these frames permit the most compact arrangement for winter and spring, and thus enable us to economize heat. By use of a division board we can, by using eight of these frames, occupy just a cubic foot of space in spring, and by repeated experiments I have found that a hive so contracted that the bees always cover the combs during the early cold weather, always gives the best results.

HOW TO CONSTRUCT THE FRAMES.

In this description I shall suppose that the frames desired, are of the form and size (Fig. 17), which I use. It will be easy for any who may desire, to change the form at pleasure.

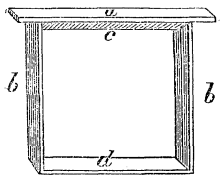

FIG. 17.

For the top bar (*a* Fig. 17) of the frame, use a triangular strip $12\frac{1}{2}'$ long, with each face of the triangle 1′ across. One-half an inch from each end of this, form a shoulder, by sawing from one angle to within $\frac{3}{8}$ of an inch of the opposite face, so that when the piece is split out from the end, these projections shall be just $\frac{3}{8}$ of an inch thick throughout. For the side pieces take (*b b* Fig. 17,) strips $11\frac{3}{8}$ inches long by $\frac{3}{4}'$ by 3-10′. Tack with small brads the end of two of these strips firmly to the shoulder of the top-bar, taking pains that the end touches squarely against the projection. Now tack the opposite ends or bottoms to the ends of a similar strip (*d* Fig. 17,) $11\frac{1}{4}'$ long. We shall thus have a square frame. The timber should be thoroughly seasoned, and of the best pine or white-wood. Care should be taken that the frame be made so as to hang vertically, when suspended on the rabbets of the hive. In making frames a good mitre box is indispensable. The projecting ends of the top-bar will rest on the tins, and thus the frame can be easily loosened at any time without jarring the bees, as the frames will not be glued fast, as they would in case they rested on the wooden rabbets.

COVER FOR FRAMES.

Nothing that I have ever tried is equal to a quilt for this purpose. It is a good absorbent of moisture, preserves the heat in spring and winter, and can be used in summer without jarring or crushing the bees. This should be a real quilt, made of firm unbleached factory, enclosing a thick layer of batting, and hemmed about the edges. My wife quilts and hems them on a machine. The quilting is in squares, and all is made in less than fifteen minutes. The quilt should be a little larger than the top of the hive, so that after all possible shrinkage, it will still cover closely. Thus when this is put on no bees can ever get above it. When we use the feeder, it may be covered by the quilt, and a flap cut in the latter, just above the hole in the feeder, enables us to feed without disturbing the bees, though I place the feeder at the end of the chamber, wherein are the bees, and have only to double the quilt back when I feed.

DIVISION BOARD.

A close fitting division board, for contracting the chamber, is very important, and though unappreciated by many excellent apiarists; still no hive is complete

without it. I find it especially valuable in winter and spring, and useful at all seasons. This is made the same form as the frames, though all below the top bar—which consists of a strip $12\frac{3}{4}'$ by $1'$ by $\frac{3}{8}'$, and is nailed firmly to the board below—is a solid inch board which is exactly one foot square, so that it fits closely to the inside of the hive. When this is inserted in the hive it entirely separates the chamber into two chambers, so that an insect much smaller than a bee could not pass from the one to the other.

BOXES.

These are for surplus comb honey in the most salable form. They may be of any size that best suits the taste of the apiarist, and the pulse of the market. It is well that the sides of these be of glass. Such (Fig. 18) may be made as follows: For top and bottom procure soft wood boards $\frac{1}{4}$ inch thick and of the size desired, one for the bottom and the other for the top of the box. Take four pieces $\frac{1}{2}$ inch square, and as long as desired height of the honey-box. In two adjacent sides of these saw grooves in which may slip common glass. These are for corner pieces. Now tack with small brads the corners of the bottom board to the ends of these pieces, then slide in the glass, and in similar way tack the top board to the other ends. Through the bottom board holes may be bored so the bees may enter. Another form which I find very desirable, and which I used in California more than ten years ago, is made as follows: Dress off common lath so that they are smooth, cut off two lengths the desired height of the box and one the desired width, tack this last piece to the ends of the other two, and to the other end tack a similar strip only half as wide. We now have a square frame. Place such frames side by side till a box is made of the desired length. To hold these together, we have now only to tack on either side one or two pieces of tin, putting a tack into each section, thus forming a compact box without ends. The end frames should have a whole piece of lath for the bottom, and groves should be cut in the bottom and top laths, so that a glass may be put in the ends. Of course there is ample chance for the bees to enter from below. Now by placing small pieces of comb, or artificial comb foundations, which rank as a discovery with the movable frame hive and honey extractor, on the top of each frame, the bees will be led to construct a separate comb in each frame, and each frame may be sold by the retail dealer separately, by simply drawing the tacks from the tins. Barker and Dicer, of Marshall, make a very neat sectional honey-box, which is quite like the above, except that paper pasted over the frames takes the place of the tins. The honey-boxes may be placed directly on the frames, or in case the queen makes trouble by entering them to deposit eggs,—a trouble which I have seldom met, perhaps because I give her enough to do below,—we can place strips $\frac{1}{2}$ inch square between the frames and boxes, thus placing that much space between them. In case we work extensively for box honey, we should have a rack so attached to the cover, that when we raise the cover, we shall remove all the boxes. Thus to examine the bees we would not have to remove all the boxes separately.

FIG. 18.

SURPLUS COMB HONEY IN FRAMES.

For our market, here at Lansing, we find a more ready sale for comb honey in frames. These frames sell best when about six by twelve inches in size and weigh about three pounds. In this case the purchaser sees all of the honey, and if nice it is very tempting. Mr. John Davis, of Delhi, Michigan, secures all of

his comb surplus in this form. If we use a two-story hive, these frames may be put in above, two deep, by plowing a horizontal groove in the centre of the side-boards, one-half inch wide, and of equal depth. The lower frames can be easily adjusted by turning them diagonally till lowered to the groove. I think it is generally better to rest content with one row of these frames, in which case we need only to have our upper story half as deep as the lower one, and arranged to take frames only half as deep.

I have found that I can get much more honey in such frames than I can in boxes.

GUIDE COMB.

I have spoken of placing guide comb in the boxes. Small pieces of worker comb or comb foundations may well be placed as a start in the top of the frames, and boxes should always have these guides. For the latter, drone comb is as good as worker. To fasten these we have but to dip the edges into melted beeswax. Strips of comb one-half inch wide are sufficient. We thus see that pieces of worker comb, and bright pieces of drone comb should never be suffered to go to waste or melted into wax.

Many people have not the ability to readily understand a word painting as to any implement, machine, or structure. Should any such wish a hive or any of the above described articles, they had better take the descriptions to a good carpenter, who will have no difficulty in following the advice. Leave orders that the hives be thoroughly painted. After seeing a hive, any one will be able to make his own.

It would be still better to visit some good apiary, or if that is impossible, to send for a pattern hive, box, etc., to some reliable apiarist. Letters of inquiry sent to me will always receive prompt attention.

TO TRANSFER BEES FROM A COMMON BOX TO A MOVABLE COMB HIVE.

As many have bees already in common hives, and of course will desire to transfer them immediately into a movable-frame hive, I will now proceed to describe the process.

The best time to transfer is early in the season, when there is but little honey in the hives, though it may be done at any time, if sufficient caution is used. This should never be done except on warm days, when the bees are actively engaged in storing. After the bees get busy at work, approach the old hive, blow a little smoke into the entrance to quiet the bees, then carry the hive off four or five rods, and turn the hive bottom up. Place another hive or box, previously prepared, over the old one, and wind a sheet about where the hives come together, so that no bees can possibly get out. Place a box on the old stand, in which the bees that are out can cluster when they return. Now with a stick rap on the lower hive for about twenty minutes. The bees will fill with honey, and go with the queen into the upper hive and cluster. A few young bees will still remain in the old hive, but these will do no harm. Now put the top hive down, leaving the edge raised so the bees can get air. If other bees do not trouble, as they usually will not if busily gathering, we can proceed in the open air. If they do we must go into some room. I have frequently transferred the comb in my kitchen, and often in a barn. Now knock the old hive apart, cut the combs from the sides, and get the combs out of the old hive with just as little breakage as possible. We now need a barrel, set on end, on which we place a board fifteen to twenty inches square, covered with several thicknesses

of cloth. We now place a comb on this cloth, and a frame on the comb, and cut out the comb the size of the inside of the frame, taking pains to save all the brood. Now crowd the frame over the comb, so that the latter will be in the same position that it was when in the old hive; that is, the honey will be above; then fasten the comb in the frame, by winding about all one or two small wires or pieces of wrapping twine. To raise the frame and comb before fastening, raise the board beneath till the frame is vertical. Set this frame in the new hive, and proceed with the others in the same way till we have all the worker comb—that with small cells—fastened in. To secure the pieces, which we shall find abundant at the end, take thin pieces of wood, one-half inch wide and a trifle longer than the frame is deep, place these in pairs either side the comb, extending up and down, and enough to hold the pieces secure till the bees shall fasten them, and secure the strips by winding with small wire, just above and below the frame, or these may be tacked to the frame with small tacks. Having fastened all the worker comb that we can fasten into the frames, —of course all the other, and all bright drone comb, will be preserved for use as guide-comb,—and placed the frames in the new hive, we now place our hive on the swarming-board or sheet, with its front raised, and shake all the bees from the cluster, from the box which we set on the old stand, and any that may have clustered where we transferred the comb, in front just as before explained when describing the method of hiving in natural swarming. After the bees have all gone in, set the hive where the old one sat. In two or three days go and remove the wires or strings and sticks, when we shall find the combs all fastened and smoothed off, and the bees as busily engaged as though their present home had always been the seat of their labors.

SHALL WE CLIP THE QUEEN'S WING?

In the above operation, as in many other manipulations of the hive, we shall often gain sight of the queen, and can if we desire clip her wing, if she has met the drone, that in no case she shall lead the colony away to parts unknown. This does not injure the queen, as some have claimed. Yet if she essays to go with a swarm, and if the apiarist is not at hand, she will very likely be lost, never regaining the hive; but in this case the bees will be saved, as *they will* return to the hive. I always mean to be so watchful, keeping my hives shaded, giving ample room, and dividing or increasing, as to prevent natural swarming. But in lieu of such caution I see no objection, and would advise clipping the queen's wing.

ROBBING.

In transferring, extracting, and in various other labors of the apiary, especially if there is a dearth of honey secretion, we are apt to induce robbing. Black bees especially are very apt to rob, and to be robbed. Italians almost always, and always if strong, will defend their stores.

Should we find our bees robbing, we have only to contract the opening of the hive which is the scene of pillage, so that but one bee can pass at a time, to put a stop to all further trespass. But the thoughtful apiarist will never fear robbers, as his colonies will be so strong that it will be a sorry day for the "tramp" that attempts to gain an entrance.

BEE MOTH—GALLERIA CEREANA—FAB.

It might be expected that this enemy would receive attention at this time, and in such a treatise. Yet if Italian bees are kept, or if the bees are kept strong,

we need have no fears of this enemy. Yet even then caution as to handling and storing comb is requisite, and so I will speak of this enemy of the apiarist.

It is certain that larvæ, the so-called worms, chrysalids, or pupæ, and the fully matured moths, and possibly eggs, exist through the winter. In April and May, and even into June, the moths will come forth. Those which survive the winter appear first, then those which develop from the pupa, afterwards those which come from the larvæ, and, lastly, those which come from eggs, providing eggs are laid in autumn. These moths (Fig. 19) are gray, with a dark stripe on their backs, and while at rest their wings are folded roof-like on their backs. The female is the larger, and has the more projecting snout, more properly palpi. (These moths belong to the family of snout moths—*Pyralidæ*.) After pairing, the female lays her one or two hundred eggs, probably on the comb, though some think any where about the entrance of the hives, or along the bottom. In a week or two, depending on the temperature, these eggs hatch. The larva (Fig. 20), which is a dirty white with a brown head, constructs a silken gallery, which it extends as its growth and needs require, and in which it feeds upon the comb or wax, which serves it for food. In from three to five weeks it attains its full growth and changes to a chrysalis in a cocoon of dirty silk, which it has previously spun. In about two weeks the moth again comes forth, and prepares for a second brood. So, while I think there are really but two broods a season, still the moths may be seen during every month of the season from April to winter.

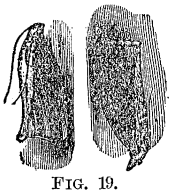

FIG. 19.

FIG. 20.

The moths are nocturnal, and are attracted both by lights and sweets. During the day they may be seen about the hive or store rooms, and though not concealed, are often quite unobserved, owing to their obscure colors.

The fact that frames and honey-boxes of comb removed from the hives of strong colonies to a secure place are often attacked by the larvæ, has led some to suppose that the eggs of the moth are laid about the hive, and carried, by adhering to the bees, to all parts. Unless an occasional moth steals in and plants her seeds of mischief, despite the most strong and wary colony, it would seem that this must be true.

REMEDIES.

Pay no heed to moth-proof hives. They are worse than useless. Make the hives well, so that there shall be no crevices in which the insects can pupate. But the sure preventive is to keep strong colonies, always possessed of queens; yea, of good, fertile, prolific queens, and no one need fear. As we have seen, this is the only wise course for many other reasons. Vessels of syrup placed about the hives at night will catch the moths.

Combs not in use should be kept in moth-proof boxes, closely watched, and if attacked, should be exposed to the fumes of burning sulphur. Honey-boxes containing honey, though not often disturbed, may need similar treatment.

OTHER ENEMIES.

The kingbird or bee-martin often preys upon both drones and neuters. Yet these birds are very valuable as insect-destroyers, and, so far as I have observed, never do sufficient harm to the apiarist to merit the death warrant.

The same may be said of the toads, which may often be seen sitting demurely at the entrance of the hives, and lapping up the full-laden bees with the light-

ning-like movement of their tongues, in a manner which can but be regarded with interest, even by him who suffers the loss. Mr. Moon, editor of the Bee-World, made this an objection to low hives; yet the advantages of such hives far more than compensate, and with the bottom-board, such as described in the chapter on hives, we shall find that the toads do us but very little damage.

In the south-west of our country, from Missouri to Texas, there is a large two-winged fly, belonging to the family Asilidæ, which does some mischief. Never having seen its evil work, I can suggest no remedy.

During the past season I also learned from various apiarists of a parasite, probably a tachina fly, that was preying upon the bees. It is to be hoped that this will give no serious anxiety. If it should become a troublesome pest, no doubt but a remedy will be discovered. Man's intelligence has always proved equal to his needs.

BEES-WAX.

Of course the prudent apiarist will desire that nothing be lost. So soiled drone comb, and *very old* worker comb, may and should be melted into wax. All other comb is far too valuable to be destroyed.

The best method to separate the wax is to put it into a strong, rather coarse bag, then sinking this in water and boiling. At intervals the comb in the bag should be pressed and stirred. The wax will collect on top of the water. If large quantities of wax are to be extracted, it is better to procure a wax extractor.

WORK FOR DIFFERENT MONTHS.

Though every live apiarist will take one, at least, of the four or five excellent journals relating to this art, printed in our country, in which the necessary work of each month will be detailed, yet it may be well to give some brief hints in this place.

JANUARY.

During this month the bees will need little attention. Should the bees in the cellar or depository become uneasy, which will not happen if the requisite precautions are taken, and there come a warm day, it were well to set them out on their summer stand, that they may enjoy a purifying flight. At night when all are again quiet return them to the cellar. While out I would clean the bottom boards, especially if there are many dead bees.

FEBRUARY.

No advice is necessary further than that given for January, though if the bees have a good fly in January, they will scarcely need attention in this month.

MARCH.

Bees should still be kept housed, and those outside still retain about them the packing of straw, shavings, etc. Frequent flights do no good, and wear out the bees. Colonies that are uneasy, and besmear their hives should be set out, and allowed a good flight and then returned.

The colony or colonies from which we desire to rear queens and drones, should now be fed, to stimulate breeding.

If from lack of care the previous autumn, any of our stocks are short of

stores, now is when it will be felt. In such cases feed either honey, sugar, or place candy on top of the frames beneath the quilt.

APRIL.

During this month the bees may all be set out. It will be best to feed all, and give all access to flour, when they will work at it, though usually they can get pollen as soon as they can fly out. Keep the brood chamber contracted so that the frames will all be covered, and cover warm above the bees to economize heat.

MAY.

Prepare nuclei to start extra queens. Feed sparingly till bloom appears. Give room for storing. Extract if necessary, and keep close watch, that you may anticipate and forestall any attempt to swarm. Now, too, is the best time to transfer.

JUNE.

Keep all colonies supplied with vigorous, prolific queens. Divide the colonies, as may be desired, especially enough to prevent attempts at swarming. Extract if necessary or best; adjust frames or boxes, if comb honey is desired, and be sure to keep all the white clover honey, in whatever form taken, separate from all other. Now is the best time to Italianize.

JULY.

The work of this month is about the same as that of June. Supersede all poor and feeble queens. Keep the bass-wood honey by itself, and remove boxes or frames as soon as full. Be sure that queens and workers have plenty of room to do their best, and suffer not the hot sun to strike the hives.

AUGUST.

Don't fail to supersede impotent queens. Between bass-wood and fall bloom it may pay to feed sparingly. Give plenty of room for queen and workers as fall storing commences.

SEPTEMBER.

Remove all surplus boxes and frames as soon as storing ceases, which usually occurs about the middle of this month; feed sparingly till the first of October. If robbing occurs, contract the entrance of the hive robbed. If it is desired to feed honey or sugar for winter, it should be done the last of this month.

OCTOBER.

Prepare colonies for winter. See that all have at least thirty pounds of good capped honey, and that all are strong in bees. Contract the entrance by using division board, and cover well with the quilt. Be sure that one or two central frames of comb contain many empty cells, and that all have a central hole through which the bees can go.

NOVEMBER.

Before the cold days come, remove the bees to the cellar or depository, or pack about those left out on the summer stands.

DECEMBER.

Now is the time to make hives, honey-boxes, etc., for the coming year. Also labels for hives. These may just contain the name of the colony, in which case the full record will be kept in a book; or the label may be made to contain a full register as to time of formation, age of queen, etc., etc.

I know from experience that any who heed all of the above may succeed in bee-keeping,—may win a double success: receive pleasure and make money. I feel sure that many experienced apiarists will find advice that it may pay to follow. It is probable that errors abound, and certain that much remains unsaid, for of all apiarists it is true that what they don't know is greatly in excess of what they do know.

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